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Real Time Flood Forecasting System Using Artificial Neural Networks

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ABSTRACT

Flood Forecasting is difficult task that faces fatal hazards due to fast rising stream flows from urban area. To avoid the future flood problems, to construct an on-line accurate model for forecasts flood levels during flood periods. The regions near Koyana and Krishna basins located in Maharashtra region is selected as study area. In this work, combining three ANNs to construct real time Flood Forecasting System. This paper suggests that the Flood Forecasting model can be valuable and very beneficial to flood control. We are considering the different location from where we can measure the outflow of the water so from which we can estimate the flood level of the location, which is affected by this location outflow directly.

Keywords : Artificial Neural Networks; Gamma Test; Flood Forecasting

I. INTRODUCTION

Floods are among the most frequent natural disasters and often cause serious losses to property, agriculture land as well as loss of human life. With changing climate these extreme events are expected to occur more frequently at different times and locations on the Earth and become more critical condition during flood. Flood is the non-linear event. Heavy rainfall events and their consequent floods are a significant concern coastal and near river banks. In coastal areas, severe floods also affect many inland catchments of the region away from the sea imposing significant damage to society and often fatalities. It is critically important to develop reliable forecasts Model for rising. [9]

Every year Nrusinhwadi, in Maharashtra, faces problems of floods and damages during monsoon. Outflow water from the from the reservoirs located in the Upper reaches of Krishna & Koyana Rivers. During flood periods, many bridges over Krishna River get submerged. In Maharashtra regions near Koyana and Krishna basins affect more, when large amount of water is withdrawn from the dam. To avoid the future flood problems, to construct an on-line accurate model for forecasts flood levels during flood periods and help people to evacuate the place before devastation. Need of the Model construction because of, when water level of the dam increases at that time large amount of outflow of water from the dam increases. Due to this, water level of Krishna and Koyana basins are increases and flood occurs. This system is helpful for the victims, who lose there homes, land, personal property, physical injury and agriculture damage in the flood. So this system is helpful for human beings in economical, geographical, social point of view.

ANNs is type of Artificial Intelligence is more efficient than traditional method.[17].Artificial neural networks (ANNs) used for nonlinear functions, and therefore become useful tools for handling water resources problems such as rainfall forecasting, stream flow forecasting, whether forecasting. Artificial neural networks (ANNs) also used for time series prediction problems.[1]

Recurrent Neural Networks is a type of artificial neural network where connection between layers forms a directed cycle[17]. This create internal state of the network which allows it to have dynamic behavior. It

has a internal memory to process sequence of input. Recurrent Neural Networks is a computational model. In Recurrent Neural Networks information flows through neurons to neurons. Recurrent Neural Networks has a interconnected neurons. RNN has don't know about input i.e. input is unknown[14].

In this study, firstly historical data collected from the Koyana Dam Maintenance Division, Koyananagar and Sangli Irrigation Department, Sangli. Extract effective factors from the data collected using the Gamma Test. Secondly, data generated from the gamma test is to be given to the training. Apart from that, patterns are generated on the data given to the training. Detection of the flood levels in three types i.e. low flood level, medium flood level, high flood level. In this work, we have combining three neural networks and form a flood forecasting system.

II. RELATED WORK

To provide the solution for the above problem there are different methodologies suggested by various people we are going to discuss some of them below.

D. Biondi, D.L. De [2] proposed a flood forecasting system that evaluates a number of flood events, the performance of a Bayesian Forecasting System (BFS), with the aim of evaluating total non-linearity in real-time flood forecasting. The performance of the BFS was performed with verification tools suited for probabilistic forecasts of continuous variables such as stream flow.

Nien-Sheng Hsu ,Chien-Lin Huang , ChihChiang Wei [3] applies an Adaptive Network-based Fuzzy Inference System (ANFIS) and a Real-Time Recurrent Neural Network (RTRLNN) with an optimized reservoir release hydrograph using Mixed Integer Linear Programming (MILP) from historical hurricane events to develop a multi-phase intelligent. The models are then constructed with either three phase modules or two phase modules.

Partly motivated by the above work Javier GarcíaPintado , David C. Mason , Sarah L. Dance , Hannah L. Cloke , Jeff C. Neal ,Jim FreerPaul D. Bates, Irene Kotsia et al.[4] proposed novel approach of Satellite based flood forecasting. Satellite based water level observations of the flood land can be sequentially absorb into a hydrodynamic model to decrease forecast unreliability. This has the potential to keep the forecast on track This system providing an Earth Observation of water level of that entire river for flood forecasting system.

Youngmin Seo ,Sungwon Kim, Ozgur Kisi, Vijay P. Singh[6] proposes water level forecasting using wavelet decomposition and artificial intelligence techniques. The objective of their proposed system is to develop and apply two hybrid models for daily water level forecasting and investigate their accuracy. As shown Fig 1 above all method requires large amount of data which will be in tabular format to test this data we use Gamma testing.

III. ANALYSIS AND SYSTEM ARECHITECTURE OF FLOOD FORECASTING SYSTEM

In this study, different types of ANNs are used to forecasts water level of that entire bridge at Nrusinhwadi. Flood levels are forecasted on three manner i.e. low, medium, high. For this study, we have to use the historical data. The data contains, Outflow of water data from each dam, water level of the Nrusinhwadi and Combination of both. In this system, we have three ANN are combined with each other and forms a Flood forecasting system. Data collected from the Koyana Dam Maintenance Division, Koyananagar and Sangli Irrigation Department, Sangli.

A. Gamma Test

Gamma Test a data analysis technique. Gamma test is used for the removing noise from noisy data and resulting in good quality data. ANN required good quality of data our data is transmitted throw network in large so there is possibility of noise in data. Use gamma test on the input data to remove this noise and get good quality of data. Input to gamma test is non-linear[12].

We have got very noisy data from Koyana Dam Maintenance Division, Koyananagar and Sangli Irrigation Department, Sangli. After applying gamma test, only extracting effective factors from input. Gamma test are widely used in the time series prediction system. Nowadays, it is used in ANNs because it reduces complexity of data and produces appropriate output.

B. Flood Forecasting System

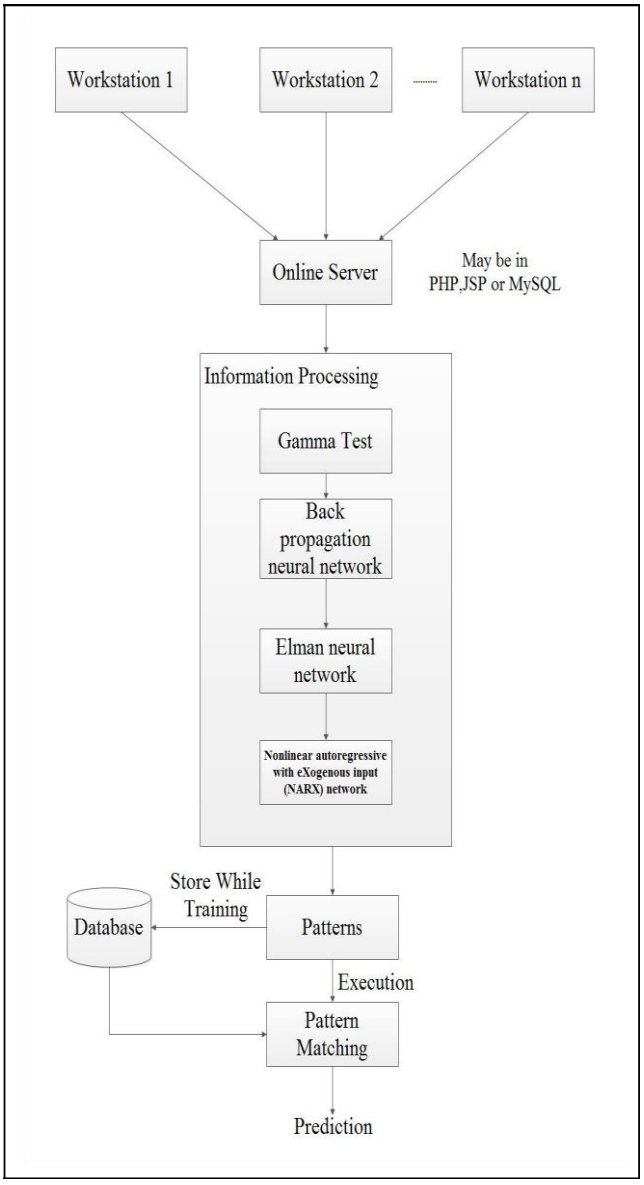

Figure 1. Flood Forecasting System

In this work, combining three ANNs to construct real time Flood Forecasting System. The Architecture of the system is shown in following figure 1. In this forecasting system, data are gather from stations and collected to server. Good quality data Gathered from the Gamma test are used for training. In the training, ,the training data is fed into to the input layer. The data is propagated to the hidden layer and then to the output layer. Read the input features, label output and define layers of network. After that, we have apply Back propagation neural network and Elman neural network applying for the calculating delta in each layer of the network.

The BPNN is feed forward neural network, have a divided into an three layers i.e. input layer, hidden layer and an output layer. In the training, the data going to the input layer. The data is grows to the hidden layer and then to the output layer. This is the forward pass of the back propagation algorithm[11].

The error between actual output values and target output values is calculated and reproduce back toward hidden layer. This is the backward pass of the back propagation algorithm. The error is used for update the connection strengths between nodes, i.e. weight between input-hidden layers and hidden-output layers are updated. The feed forward of the testing data is similar to the feed forward of the training data.

Elman Neural Network is a three layered Recurrent Neural Network[16]. It has a time-delay feedback connection in the hidden layer. Applying NARX on the input data calculate weight value and add bias value in the neuron in each layer of total network. The NARX[13][14][15] network is a recurrent network, which is suitable for time series prediction. The NARX[13][14][15] network consists of three layers.

IV. EXPERIMENTAL RESULTS

The Table 1 shows the different outflow of water data from each dam.

Table I. Outflow of Water From Each Dam

Dam	**Outflow of Water from Each Dam (In Cusecs)**	
Koyana	0	0
Dhome	0	0
Kanher	49	49
Warana	0	0
Dhudhganga	300	300
Radhanagari	0	0
Tulashi	0	0
Kasari	0	0
Patgaaon	0	0
Dhome Balkawadi	0	0
Urmodi	0	0
Tarali	0	0

When we take the input as above and water level, we get the flood level at Nrusinhwadi Bridge , this results are accurate and accuracy level is 100% it means if we put past generated data as it is then difference between the actual value and system predicted value are accurate.

To Train the system we use the data set from Sangli Irrigation Department. Which include the Outflow of the 12 dams which effects the water level of Krishna River at Nrusinhwadi.

We have used 200 record to Train the system so because of that it will give result that is more accurate. For Different training sets and testing sets we have following results.

Table II. Datasets and Parameters

Sr. No.	Number of sample	Time require for training (Sec.)	Time require for Testing (Sec.)	Accuracy (%)
1	50	5	2	85%
2	100	10	6	90%
3	150	15	9	95%
4	200	20	12	100%

From the above table we can conclude prediction of our system is become more accurate as we increase the training data .but the duration for processing is also get increased but the duration will not be a major issue when we use the system once or twice in a day. For above table all the values are the average of 5 observations.

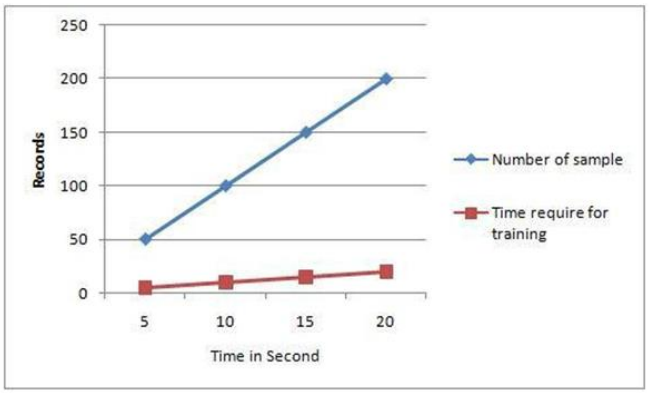

Figure 2. Time required for a training over the number of records

The system is also trainable again with new update records. Time required for a training over the number of records as shown in figure 2.

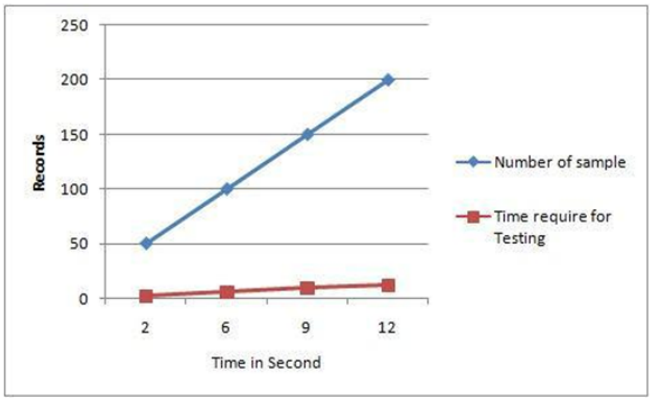

Figure 3. Time required for a testing over the number of records

Apart from that, Time required for Testing over records as shown in figure 3.

Training data Accuracy of the flood forecasting system is increases when number of records are Increased as shown in figure 4.

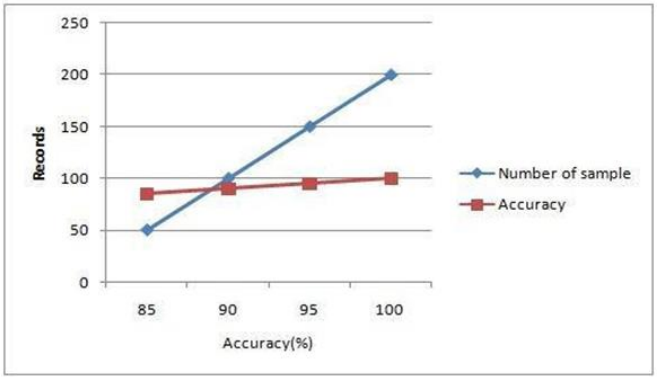

Figure 4. Accuracy over records

The final output of the work takes the input from user and predicts the water level in a low, medium, high flood level manner.

V. CONCLUSION

In this work, combining three ANNs to construct real time Flood Forecasting System. This system is suitable for flood forecasting because of each time a system is trained, can result in a different solution due to different giving initial weight and bias values and different bisection of data into training and testing of data. As a result, neural networks trained on the same problem can give different outputs for the same input.

To ensure that, this neural network has good accuracy has been found, keep several times.

We can conclude prediction of Flood Forecasting System is become more accurate as we increase the training data. But the duration for processing is also get increased but the duration will not be a major issue when we use the system once or twice in a day.

We have calculate performance of Flood Forecasting System by considering of various datasets parameters like number of Records and Time required for training and testing in this paper .

VI.ACKNOWLEDGMENT

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