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# Flood Forecast Development using Machine Learning

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Abstract— Flood is large amount of water passing an overflow on a land. Flood forecast (FF) system issue a warning corresponding to water level or dischargesthrough hydraulic structures. Flood forecast (FF) increase the capability and advancement in hydrology to mitigate the hazards using machine leanings with ANN. Flood forecasting using machine learning algorithm (MLA) method understand to learn and improve system scale to mitigate flood hazards according to the climate change. This research is carrying out for flood forecasting on Upper Wardha project across Wardha river basin. Flood forecasting (FF) using real time estimation gives chances of flood value and by using the forecasted inflow, rate of inflow in reservoir can decide the time of operation i.e. opening and closing of gate in real time with ANN.

***Keywords***- *Flood; ANN; Machine Learning; Real Time*

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## I.INTRODUCTION (HEADING 1)

For many large rivers, flood plain protections areas have very low areas to protect against flood during the time of heavy rainfall. Flood early warning mitigates the minimization of hazards towards structural and non structural losses. Flood forecasting model based on river characteristics, natural characteristics of weather, topographical conditions. Flood forecasting is a technique based on time and duration of flood.

Flood forecasting models depend on water levels of river, rain gauges data, satellite weather conditions, Topographical and Geological Conditions. Flood forecasting gives early warning to administrator to reduced haphazard's towards happening the hazards. Flood forecasting is very important for public and environment safety. Rivers have non linear behavior towards flow. Flood forecasting technique required very accurate routing method at the downstream end. Flood forecasting models minimize errors lead to uncertainties occurs in the hydrological model in real time.

Flood forecasting technique used to develop early warning system with respective time and duration for any watershed. Flood forecasting technique provide model in such a way to minimize calibration and maximize validation to reduce the hazards. Flood forecasting technique is used to predict initial water levels and HFL river or in watershed during the rainfall – runoff with duration. Flood forecasting using AI use to design of intelligent system to mitigate the losses during occurrence of flood. Machine learning algorithm (MLA) is used to developed application for flood forecasting to mitigate flood hazards.

Flood forecasting using past and real data records of flood and water levels, rain gauges records in real time, data sources of rainfall-runoff with real time sources, infiltration of water is used develop a machine learning algorithm.

The present study is carried out to developed is carried out on wardha river, Godawari basin. The upper wardha project consist spillways and canals to pass surplus of water on downstream side with controlled gates. The

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upper wardha watershed has gross capacity of 786 MCM with annual rainfall in the catchment is 840 mm. The present study is able to give flood forecasting using ANN to reduce losses population and environment in real time with early warning to administrator for opening of gates of dam.

## II.LITERATURE REVIEW

Muskingham equation is used for flood forecasting using combination of single and multi inflow model form on Tar River basin [11]. Real time flood forecast is used for Godavari River basin with improved time 12 hr as compared to conventional method with model accuracy improved by computing flood plain inundations [12]. ANN model tool used to forecast flood [13]. Stream flow estimation using multiple linear regression to generate Rainfall – Runoff data [14]. Overview on different methods for Flood Forecast and Early Warning with advanced development in England, Scotland [15]. A comparison between statistical and ANN method for flood forecasting in river Mahanadi, ANN methods are better beyond the calibration and efficient [16].

## III.METODOLOGY

A.Hydrological Models of flood forecasting Flood forecasting model depends upon runoff, rainfall, catchment characteristics and spatial extent. Stochastic models reflect techniques based on time-series analysis, which have become very popular in hydrology [17]. Hydrological modeling for flood forecasting is nothing but state of art, locks and challenges, regarding the whole forecasting system

B.ANN and Machine learning Approach for flood forecasting Neural Networks, which are simplified models of Biological Neuron System. An Artificial Neural Network is data processing system consisting a large number of simple highly interconnected processing elements [18]. ANN is classified into single layer, multilayer feed forward network and Back Propagation Network.

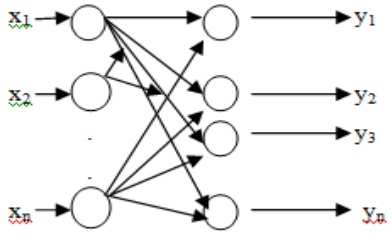


Fig.1. Neural Network Model

C.Machine Learning Method

Real time model is based on actual available and real rainfall and runoff data with time. The following flow chart will give you a concept of real time flood forecasting. Flood forecasting is the process off calculating water levels in reservoir, the storage quantities and outflow rates at particulars inflow hydrograph at various instant. Flood occurrence mainly depends upon various parameters like a rainfall intensity, runoff, evaporation, evapotranspiration, temperature and shape of catchment etc. By interpreting the data for flood routing the technique used i.e. Muskingum Equation which gives the value of inflow and outflow rate. The data obtained from reservoir routing is given to the machine learning, to learn and forecast by the real time data. The Muskingum method of stream flow routing is most frequently used because of its simplicity, as it works with known inflow hydrograph and some fitted parameters without seeking additional information. However, in order to get high degree of accuracy, this method should be for gradually varied flow and not in cases where reach is often affected by back water or unsteady flow condition

The governing relation between inflow, outflow and change in storage is

$$\vec{I} - \vec{O} = \Delta S$$

Storage=inflow-outflow

Where

$\vec{I}$ = Average inflow during a given time period

$\vec{O}$ = Average outflow during given time period

ΔS= Volume of water stored in the reservoir.

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$$\sum_{S=1}^{S=n} S = \sum_{j=\Delta t}^{j+1} I(t)dt - \sum_{j=\Delta t}^{(j+1)\Delta t} Q(t)dt$$

The inflow values at the beginning and end of the j-th time interval are Ij and Ij+1 respectively and corresponding the value of outflow are Qj and Qj+1.

Machine learning is an application of artificial intelligence

(AI) that provides systems the ability to automatically learned and improves from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.

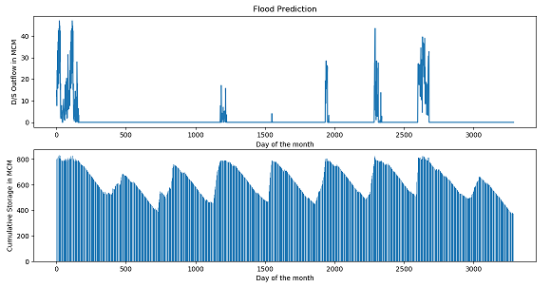


Fig.2: Cumulative Storage and days

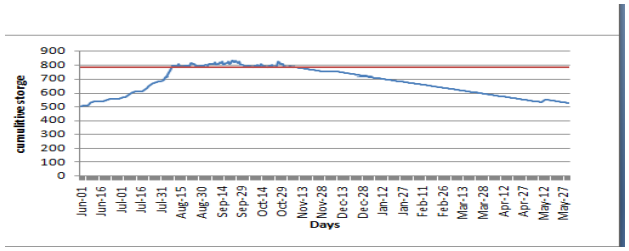


Fig. 3: Cumulative storage and days by stochastic method

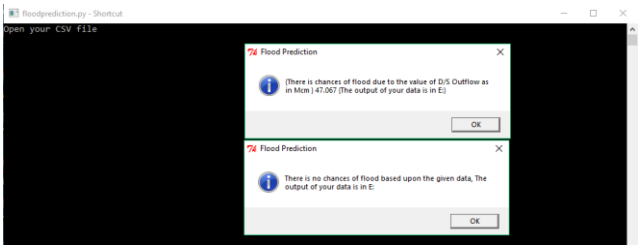


Fig.4:- Flood Forecasted value of outflow for opening of gates

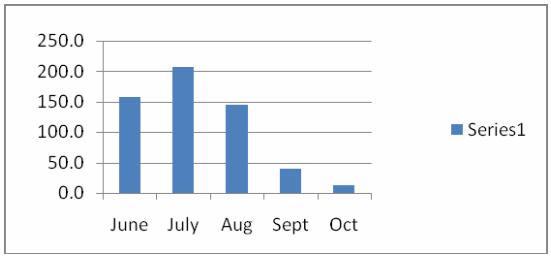


Fig.5:- Hyetograph

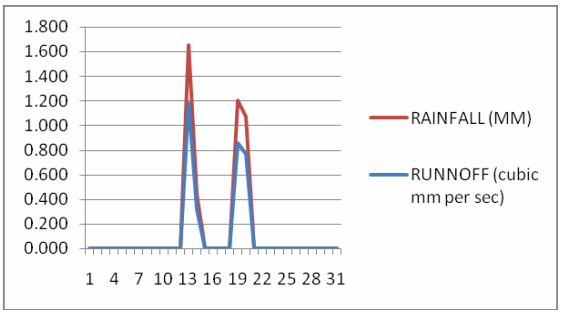


Fig. 6 Rainfall Runoff

The flood forecasting technique studied and gives a suitable method may be recommended for field applications based on the performance evaluation criteria and considering the data availability. Flood forecasting using real time estimation gives chances of flood value in GUI. Flood estimation using Machine Learning in real time can calculate large data instantly. Comparison between flood modelling by machine learning and stochastic method (i.e. Muskinghum method) gives machine learning is accurate, easy and can be applied for numbers of calculation. By using the forecasted inflow, rate of inflow in reservoir can decide the time of operation i.e. opening and closing of gate.

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