

Predicting Disasters: A Machine Learning Approach

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Abstract:

Trends in river water levels that could cause floods are an intriguing and applicable subject of study. They set up shop to lessen the financial and social impact of floods. Water level variations can be predicted using support Vector, a class of machine learning methods that can also be used to detect the likelihood of flooding. The two algorithms use comparable hydrological and flood resource variables in the process of predicting floods, such as the prediction amount, River inflow, seasonal flow, flood frequency, and other pertinent flood prediction variables, because the water level is the most important factor in hydrological research. Machine learning techniques are helpful for predicting floods because they have the ability to classify and regress data from several sources into groups of flood and non-flood. Anyone may use the Machine Learning and Deep Learning features of artificial intelligence thanks to Watson Studio.

Keywords: forecasting, Disaster Management, machine learning, deep learning.

I. INTRODUCTION

India consistently ranks as the most flood-prone country year. Cities' low-lying areas are more vulnerable to flooding. There are a number of important variables that have led to the increase of water logging, including surface runoff, relative height, and insufficient passage of the water to drainage. Flood forecasting is especially important there. Several Indian states have been hit by flooding in the past year. These include Assam, Bihar, Goa, Odisha, Pune, Maharashtra, Tamil Nadu, Karnataka, Kerala, and Gujarat. Chennai received 1049 mm more precipitation than average during November 2015, the wettest month of the year. Rainfall of 1088 millimeters in November was the highest since records began in 1918. The Kanchipuram district receives an average of 64 centimeters of precipitation between October and December. The highest rainfall total was recorded there at 181.5 cm, which is 183% greater than normal rainfall. However, 146 cm of rain was measured in the

Tiruvallur district. There has been a lot of effort put into developing systems for foreseeing floods, but not all of them provide particularly reliable estimates. Machine learning offers a plethora of solutions to improve the accuracy of problem predictions. In this study, we propose estimating the flash flood as a means of protecting flood-prone areas. The strategy is geared on developing a functional model of an ML algorithm. Improved short-term forecasting in urban areas is achieved by factoring in the risk of flooding[6][7][27].

Gauge sensors and remote sensing devices are only two of the many tools available for tracking floods. However, there are limitations to remote sensing technologies, such as the length of time between satellite visits, and the limited spatial resolution of gauge sensors. Recovering from a data loss might take anywhere from a few minutes to a few hours. Due to its reliance on water level sensors and precipitation forecasts, existing flood warning analysis is unable to offer near-real-time and automated flood monitoring analysis. As a result, visual sensing devices have been created, capable of collecting vast amounts of data in a targeted area. There are countless applications that make substantial use of the information included in both moving and still photographs. With the advancement of surveillance technology, more people are considering installing visual monitoring and surveillance systems, especially in disaster-stricken areas.[8][25][26]

II. LITERATURE SURVEY

J.Akshaya and P.L.K. Priyadarshini [1]

The recent flooding in several parts of southern India has caused significant loss of life and property. Resuming normal life after a devastating natural disaster like a flood might take a long time. Drones are only one example of the technology used during disasters to speed up relief efforts and reduce property loss. Remote sensing and aerial picture analysis automatically need a large number of algorithms. Drones with high-quality cameras and sensitive sensors are replacing traditional aerial photography in many applications. This research suggests a hybrid method for determining whether or not an area in an aerial photograph has been impacted by flooding. Support Vector Machine (SVM) and k-means clustering, when used together, were able to properly categorize around 92% of flooded photos, demonstrating their efficacy in detecting flooded areas. Altering the SVM's kernel functions is how performance is analyzed. The results demonstrate that using quadratic SVM cuts down on both prediction and training times[11][12].

A.B.Ranjit and P.V.Durga [2] One of the most pressing and difficult issues in hydrology is flood forecasting (FF). Forecasting and warning for flooding is widely recognized as the single most effective non-structural measure for mitigating flood losses. A reliable flood warning system should alert residents with the time to prepare. The purpose of an accurate flood forecast is to give authorities and citizens as much warning as possible before a flood strikes. The development of hydrological models, the expansion of analytical expertise, and the enhancement of data collecting via satellite observations have all contributed to an increase in the accuracy of forecasts. In this work, we examine several facets of flood forecasting, including the models employed, data collection methods, visualization strategies, and alerts[9][28][29].

F. A. Ruslan, K. Haroon, A. M. Samad and R. Adnan, [2017]

Many states in Malaysia, especially those on the east coast, are vulnerable to devastating floods at the end of the year because of Monsoon rain. Numerous people saw significant financial and property losses. In light of this, an alert system predicated on a reliable model for predicting flood water levels is required to give advance warning to the impacted area and its residents. Models for predicting floods were developed using the Multiple-Input, Single-Output (MISO) Auto regressive with Exogenous Input (ARX) and the Multiple-Input, Single-Output (MISO) Auto regressive Moving Average with Exogenous Input (ARMAX) architectures, and their predictive capacities were evaluated. The parametric models were developed with the help of the MATLAB System Identification toolkit. Information for this case study was gathered at five different locations along the Pahang River in Temerloh, Pahang: four upstream sites and one downstream station. The data utilized in this analysis were collected and compiled by the Malaysian Ministry of Drainage and Irrigation. In terms of Best Fit value and rise values, the simulation results showed that the ARMAX structure-designed flood prediction model performed better than the ARX structure-designed model[10][19][20].

[3]In many parts of the world, floods are among the most devastating natural disasters that may strike. Particularly in the Philippines, this was a huge problem because of the potential for material loss, infrastructural destruction, and even human casualties. Current systems strictly adhere to problems to prevent disastrous flood disasters. In this research, we use real-time data from monitoring devices to create a model that can forecast when and where floods will occur. Based on data from sensors in a real-time monitoring system, the system makes accurate flood level predictions in advance. The prediction model was created using a multi-layered artificial neural network and MATLAB. The network's goodness-of-fit was excellent across all four datasets (0.99889 for the training set, 0.99362 for the test set, 0.99764 for the validation set, and 0.99795 for the full dataset)[13][14].

III. EXISTING MODEL

When rivers, creeks, and other waterways transport an excessive amount of water to a region that lacks sufficient drainage, flooding results. In the last 20 years, floods have harmed over 2.3 billion people, causing countless deaths, destroying over 92 billion head of cattle annually, damaging seven million hectares of land, and costing over \$5 trillion worldwide in just the last five years[15][16].

Limited data availability and the definition of events can contribute to data-related difficulties. Difficulties in drought and flood models arise from a lack of data, which makes it impossible to describe the entire diversity of extremes. When doing extreme value analysis, the decision on which event description to utilize is critical. Observations of stream flow are used in both statistical and hydrological models for purposes of calibration and evaluation. However, it's possible that these records don't exist, exist only temporarily, or have holes in them. It's also possible that data aren't readily available to the public because of issues like measurement mistakes or in homogeneities. It's also possible that we're missing spatial data and details about the variables that affect stream flow. We explain these types and how they influence flood and drought prediction models in the following paragraphs[17][18].

No stream flow observations:

This difficulty is especially felt on the African continent due to the fact that observed stream flow records are only available at the precise areas along a stream where a gauge has been installed and station density may be low[21][23].

Data access:

Due to data licensing limitations, rigorous access controls, or the time needed to make these datasets readily useable at the global scale, publicly available stream flow datasets are still uncommon. Storage in decentralized databases, generally maintained by regional rather than national authorities and often only accessible in the local language, further impedes data access[24]

IV. PROPOSED SYSTEM

In proposed system, we implement a Machine Learning algorithm for getting insights from the complex patterns in the data. This technique is computationally inexpensive because of its simple architecture. And here we are using XG Boost Algorithm for great Data Access and Accuracy.

In order to manage environmental and water resource systems, as well as to set insurance rates and evacuate individuals from flood-prone areas, accurate flood forecasts are essential. Floods and droughts are two of the most common natural calamities in India, both of which may be traced back to the unpredictable nature of the monsoon. Highest death reported due to flood & drought. Need some solution to give prior indication of flood & drought.

Data Set

The data set consists of 630 records and features are Date District, State Mar-May, Jun-Sep, Oct-Dec, of type string and Numeric the dataset is derived from the Kaggle.com and google websites. By using these dataset we can Predict the floods these dataset will be in the csv format. By using dataset we can predict the future floods.

Data Training

Our model is trained with XG Boost and other machine learning techniques using a pre-processed training dataset. The viewer then views the categorized results.

Measures to compute

The dataset is trained using a variety of different algorithms, including SVM, LR, KNN, and MLP.

The calculating variable.

1) Precision: Precision refers to the rate at which a positive prediction is corroborated by data. True Positive (TP) and False Positive (FP) both stand for the same thing.

2) Recall: Recall is the ratio of observed positive values that is correctly predicted.

Formula: $TP/(TP+FN)$

3) F1Score: F1score takes the (1) and (2) for the calculation. It gives the average weight.

Formula: $F1score=2(Precision*Recall)/(Recall+Precision)$

4) Sensitivity: Sensitivity is also called a Recall. TP becomes higher when the sensitivity value is higher.

Prediction Results:

Class 1: Floods Found

Class 2: Floods not found

If the given water millimeter is higher than 2400 it will be 1 or if it is lesser than 2400 then it is 2.

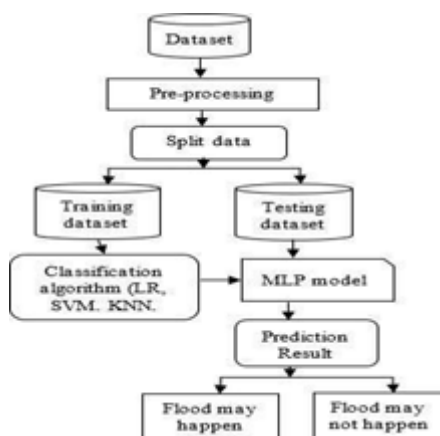


Figure 1: Prediction Result

The figure shows the steps taken before separating a huge data set into two distinct groups. Both a training and a test dataset. We use the Logistic Regression, Support Vector Machine, K-nearest, and XG boost classification algorithms in the training data set, and the Multilayer Perceptron (MLP) model in the testing data set. Then results will get with higher accuracy in binary values either flood may happen or Floods may not happen. This is the way we will predict the results.

User Register

The user needs to register.

About-Project

In this application, we have successfully created an application which takes in and at a set and predicts the Floods happen or Floods not happen in the Particular areas.

Login

A registered user can login using the valid credentials to the website to use a application.

Upload Dataset

The user has to upload an dataset inform at of csv files which needs to be tested.

Prediction

The results of our model are displayed as either Floods happen or not.

View Results

View the results that floods happen or not.

Logout

Once the prediction is over, the user can logout of the application

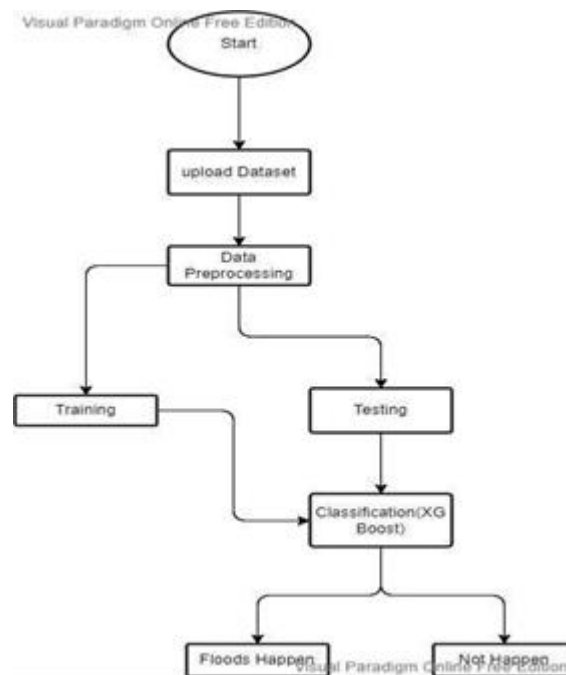


Figure 2 -Architecture

In this architecture first we are uploading dataset after uploading raw data we have to preprocess it in 2 ratios 80:20 . 80 percent is training dataset and 20 percent is testing. And classification we are using XGBoost Algorithm. And we are getting the results Floods Happen or Floods Not Happen.

V. IMPLEMENTATION METHODS

Logistic Regression: Logistic regression is a statistical model. Here we use Probability technique of 1 event out of 2 alternatives. Here in logistic regression here we use only binary values either 0 or 1 to model the probability of certain class or event taking place. In our prediction we use logistic regression it's prediction tie is 0.9288. it will tell only either Floods may happen or Floods may not happen. In threshold it will show as S curve. The Categorical responses are only two outcomes.

KNN Algorithm: KNN algorithm is an supervised learning algorithm. Here it can use for both classification and regression technique to assign weights. It Takes the nearest values If K=3 if distance is close to one classifier then it will move to 1 classifier. Here It calculates Distance and Weights.

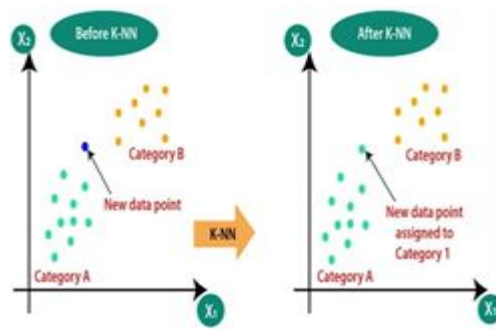


Figure 3.-KNNAlgorithm

Here we can see that in this fig the blue point is a new data point. Category a and category b are neighbors. This algorithm calculating nearest distance new data point is assigned to category because the distance is very less comparing to category b.

Support Vector Machine:

In Support vector machine we can analyze the data by using either Classification technique or Regression model Here We have 2 categories to train the data set if new data comes it can easily categorize under a particular group. It is called as non-Binary Linear Classifier. In Support vector machine we train a large data with all the features. And then we will give them to one strange data by using hyper planes Support vector machine will find the best route or best boundary decision. In support vector machine we use ML classifier to predict the floods but its accuracy is 0.9666. So with is algorithm our measures are not giving best accuracy.

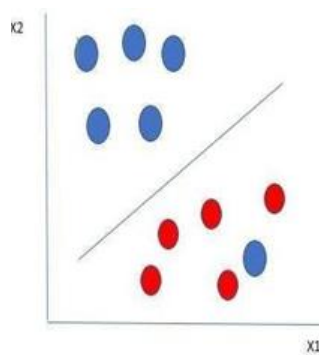


Figure 4 : Support Vector System

In this Figure we can see the best hyper plane boundary and X1 and X2 are two independent variables. By using KNN Classifier and by using previous data we can find the best margin. This hyper plane margin is Soft Margin.

XG Boost algorithm:

In our Prediction modeling we are using XG Boost algorithm. Because it's regularized boosting and prevents over fitting. It can handle missing values automatically. This is a parallel processing method with the added benefit of iterative cross-verification. It lets you set your own optimization goals and do tree pruning, as well as identify the ideal number of iterations. Causes trees to grow deeper but more optimally

FrameWork:

Here we use the Frame Work called PyCharm by using Prediction modeling techniques we install the package called XG Boost and also interfaces NumPy files Sickit_learn. The reason it doesn't share Scikit_learn's APIs is that it was built independently. Features and labels are stored in a D Matrix Structure. Using & all parameters supplied via a dictionary, we can quickly and easily generate it from a NumPy array. Then we'll refer to the data as "trained" in order to make accurate predictions.

XG Boost Hyper parameters: Here we use booster technique Gbtree orgb linear objectives of hyper parameters is multi: SoftMax, and multi: Softprob and the learning rate is Adjusting Weights and also here we are calculating Max depth of the trees and Minimum Child weights of the trees. And the data set splits into 2 phases training set and testing sets 80% using dataset as training set and 20% as testing dataset parameters are Class _Weight, max_depth, min_depth. We are measuring the power of prediction in various algorithm here comparing to all algorithms XG Boost giving the highest accuracy because it has over fitting feature and boosting, bagging techniques there is an optimization and improvement in this picture when we compare to logistic regression and XG boost 0.9662 is the XGboost accuracy. And the training time in seconds is 24 seconds. This is the prediction power of XGBoost algorithm. Because of this it provides cache awareness.

In the Figure We are measuring the power of prediction in various algorithm here comparing to all algorithms XGBoost giving the highest accuracy because it has over fitting feature and boosting, bagging techniques there is an optimization and improvement in this picture when we compare to logistic regression and XG boost0.9662 is the XGboost accuracy. And the training time in seconds is 24 seconds. This is the prediction power of XGBoost algorithm. Because of this it providing cache awareness.

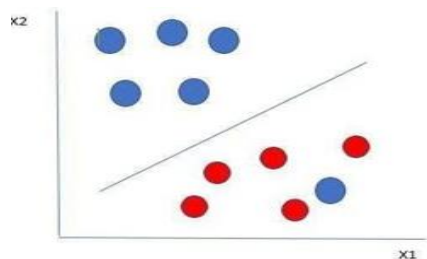


Figure 5: - XG-Boost Algorithm

VI. EXPERIMENT RESULT

Analysis of various Classification algorithms to predict the floods:

Table 1- experimental result

Parameter	Logistic Regression	Support Vector Machine	K-Nearest Algorithm	XG- Boostalgorithm
Precision	0.66	0.87	0.86	0.988
Recall	0.87	0.89	0.88	1
F1-Score	0.82	0.90	0.89	0.98
Sensitivity	0.87	0	0.87	0.99
Accuracy	90.3	93.2	95.85	97.4

In the above table we can see that various analysis of classification Algorithms for Flood Prediction Here we are using parameters to calculate the accuracy to predict the floods. In Logistic Regression 0.66 is the precision in SVM 0.87, and K-N 0.86, but in XG boost algorithm has highest precision 0.988 Compare to all the algorithms XGboost giving better accuracy to predict the floods. Recall is a parameter to find the ratio values compare to the other entire algorithms XG boost giving more accuracy. The accuracy is 1. F1 score is used to calculate average weight of recall and precision after averaging accuracy is 0.98. So as per analysis we can see the measures XG boost giving better accuracy within 30sec we can find the values for the data.

Table 2: INPUT PARAMETERS

S.no	Mar-May	Jun-Sep	10days_june	Rainfall	happen(0)
1	386.2	2122.8	274.8666667	649.9	0
2	275.7	2403.4	130.3	256.4	1
3	336.3	2343	186.2	308.9	0
4	339.4	2398.2	366.0666667	862.5	0
5	378.5	1881.5	283.4	586.9	0
6	230	1943.1	138.3	254.1	0
7	328	2737.8	256.9666667	669.5	1
8	283.7	2023.6	197.5333333	450	0
9	628.3	1940.4	234.9	231.5	0
10	296.7	1886.5	226.6666667	531.2	0
11	303.1	2167	232.0333333	541.6	0
12	240.4	1851.7	234.5666667	580.8	0
13	767	1104.3	154.7666667	218.7	0
14	346.8	2025	212.2666667	389.8	0
15	283.7	2318.2	321.4333333	876.6	0
16	202.3	2928.4	240.8333333	642.5	0

Floods Happen (1) Floods not

10 REPORTS

S.NO	User Name	Algorithm Used	Percentage	Floods Happen	Floods Not Happen
1	Vineeta	XGBoost Algorithm	0.9999	NO	yes
2	Vineela	Logistic Regression	0.8787	No	yes
3	Shabana	Decision Classifier	0.88686	yes	No
4	Deepthi	KNN Algorithm	0.87898	Yes	No
5	Vinay	XGBoost algorithm	0.9898	yes	No
6	Akshaya	XGBoost algorithm	0.9898	yes	No
7	Ahalya	XGBoost algorithm	0.989899	No	Yes

8	Amulya	XGBoost Algorithm	0.99999	No	Yes
9	Lucky	XGBoost algorithm	0.9898	yes	No
10	Vandana	XGBoost algorithm	0.9898	yes	No
11	Gourav	Decision Classifier	0.88686	yes	No
12	Sahithi	Decision Classifier	0.88686	yes	No
13	Harika	LogisticmRegression	0.8787	No	yes

CONCLUSION

Floods are Natural Disasters we cannot predict. It is impossible to Prevent the Floods with100% Accuracy but the fact is we can prevent it 0988% using XG boost prevention model. By using this we can prevent some of economical losses before floods occurrence. Every year more than 200000 people are losing their lives because of floods we can prevent it by alarming method of flood prediction. Here we used many algorithms like Logical regression, K-Nearest algorithm, Support vector machine, XGBoost algorithm. In this K-nearest algorithm accuracy

LIMITATIONS

To function as intended, every system must be constrained in some way. While developing this project, we ran into a few issues and constraints, such as the following: This project requires constant access to the internet; without it, we can't do anything.

FUTUREWORK

This can be utilized in future to classify the types of different algorithm and we are planning to invent mobile application alarming system so that rural areas can also access this prediction technique before the flood occurrence.

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