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FLOOD DISASTER PREDICTION USING DEEP LEARNING ALGORITHM

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Abstract: Floods are one of the most cataclysmic events in the face of Earth, which are exceptionally unpredictable to demonstrate and difficult to predict at an earlier point of time. The examination of improvement of flood-forecast designs has added to diminish hazard, policy suggestion, minimization of the loss of lives and damage caused to properties pertaining to floods. To reenact the compound numerical interpretations of physical actions of floods, during the last two decades, neural system blueprints have assisted in improving and advancing flood prediction structure providing better execution and cost-effective solutions. This project helps predict the occurrence of a flood by rainfall dataset with neural network-based techniques to prevent this problem of floods. The analysis of the dataset by Multi-Layer Perceptron Classifier (MLP) is carried out to acquire certain information like; variable identification, treatment of missing values, data validation and data cleansing and preparation will be done on the complete provided dataset. The performance of the algorithms utilized for flood forecasting is seen by the accuracy computation with an evaluation classification report, confusion matrix identification and result. It shows the effectiveness of the graphical user interface-based application by predefined attributes and gives an early alarm for an impending disaster.

Keywords: Support vector deep, Random forest, Deep learning, Earthquake prediction, Dataset.

1. Introduction

The objective is to build an AI model for ongoing flood estimation, to almost certainly supplant the versatile multi-layer perceptron (MLP), neural system models, by foreseeing brings about the type of exactness. In urban communities, sub-passes, or low-lying areas are generally helpless against water logging and waste issues. In such flood-vulnerable points, water gets gathered pointlessly in a brief span of time. Surface spillover, relative rise and a deficient section of water to sewerage are important focuses on the situation of water logging. In this way, estimating floods at such locations is significant and dire. The run of the mill techniques of flood gauging is

upscale and profoundly intricate. Prediction of weather, along with rainfall prediction, is a significant task behind the forecast of a flood. Climate determining includes re-enactments dependent on material-science and differential conditions. The forecasting of rainfall is done using satellite imaging radars. A Doppler climate radar is utilized to find the amount of rainfall received and recognize the movement of rain droplets. A committed climate satellite gives pictures utilizing which data about precipitation can be reasoned and it's for momentary flash-flood forecast in urban regions is to set up a model assimilating the factors affecting flood and utilize the intensity of AI systems to evaluate flood early. Fast urbanization, environmental development, and intense precipitation have brought about developing instances of flash-floods in metropolitan areas. It is imperative to foresee the event of a downpour so that its fallout is limited. According to its name, an urban flash-flood happens in a metropolitan territory in an extremely limited period of time. To diminish the effect of these occasions, transient determining or now-casting is utilized for forecasting of the very near upcoming occurrences. In customary strategies for flood gauging, current climate conditions are inspected utilizing regular techniques, for example, the utilization of radar, satellite imaging and several evaluations including confounded scientific conditions. Be that as it may, late improvements in Deep Learning(ML) and Information and Communication Technology (ICT) have aided us in contemplating this issue from an alternate point of view. The fact of the matter is to structure a model keeping in mind the criterion causing the above type of flood and foresee the same ahead of time..

2. Related Work

There are various deep learning (ML) algorithms that have been previously used for the prediction model for Floods and Earthquake. M Khalaf et al. [1] discussed the use of various ML algorithms for prediction of a flood's severity and classification of the floods into three classes, normal, high-risk and abnormal floods. It produced enhanced results for pre- processing of flood dataset based on time series. The models used for comparative accuracy prediction included Random Forest Classifier (RFC), Support Vector Deeps (SVM), Levenberg-Marquartdt training algorithm (LEVNN), Linear Neural Network (LNN) and RFC performed better using the performance measures examined.

J Opella et al. [2] used the data available on the Geographic Information System (GIS) to generate reliable flood disaster susceptibility and probability maps. Fusion Convolutional

Network was used along with Support Vector Deep for a better image map result. Flood mapping system is used to calculate the range and approximate depth of water in flood affected areas. In this paper, we intend on using Artificial Neural Network and not Convolutional Neural Network as the data is not in the form of visual imagery.

S Saravi et al. [3] discussed the use of Artificial Intelligence on the big data, that was collected from previous other flood disaster events to train the algorithm about past events and also extracted information and patterns, and understanding flood's behavior to improve the degree of preparedness and prevent damage in the events of disaster. Random Forest technique is being used as it guarantees the highest rate of accuracyforclassification.J48 decision tree and Artificial Neural Networks (ANN) are next in line for predicting flash flood and Lazy methods. Disaster monitoring methods used in the paper are based on detection algorithm based on change, where the area affected can be recognized using a complex study on pre disaster and post disaster event data. This paper helped us understand the working of ANN and Time Series Algorithm to predict upcoming disasters, which is being implemented in the pre disaster analysis phase of this paper.

F Ahmad et al. [4] used Deep Learning models for early identification and future earthquake prediction by analyzing continuous time series data. Seismic stations continuously gather data which can be used to identify earthquake prone regions. The first phase uses the K-means algorithm for clustering applications to gives the result as clusters for different earthquake locations. A Ranit et al. [5] developed a model for a reliable flood forecasting system where the reliability is based on the ability of the system to provide advance warning. The modelis designed based on the scale, types of flood, flooding behavior, types of landscape. The various approaches used are statistical, ANN and clustering approaches. This paper helps us understand the working of application software for the deployment of a disaster prediction, warning system and post disaster report.

S Abdullahi et al. [6] designed a Flood monitoring system which combines the uses of water level sensors and flow sensors. It uses neural network and Microsoft's Azure Deep Learning. The updated data from sensors is made available using ANN, weather radar images and hydrological flood mappings. Azure Web Services is used to predict with the Common Information Space (CIS) along with neural state cloud. Flow rate monitoring and water level monitoring are evaluated based on accuracy, recall and precision and ROC curve for true

positive versus false positive. This paper is used to understand the deployment of Azure services for post disaster analysis.

3. Proposed work

A flash flood is an immediate reaction to a place receiving precipitation having extremely high magnitude in a small timeframe. These sorts of floods are normally observed in urban regions of society where the primary land can't hold, or channel additional water elsewhere quickly by means of sewage frameworks and depleting waterways in a brief timeframe. As of late, the impact of floods in urban territories is highly visible in several cities, for example, Ahmedabad, Chennai, Mumbai and Trivandrum. Incorrect and delayed flood forecasting, poor urban planning, and inadequate flood moderation framework are the primary reasons behind this. Given dataset from various sources is used to form a generalized dataset, and applied to derive patterns and to get results with best efficiency. At this stage, the dataset will be used to stack in the information, check for tidiness, and afterwards, cut down and cleanse the given dataset for further examination. It is ensured that the given record steps cautiously and explains cleansing choices. The dataset used for analyzing given information is partitioned into a Training set and a Test set. Normally, 7:3 proportions are applied to perform this classification. The Data Framework which was formed using the Multi-Layer Perceptron Classifier will be applied to the Training set. Based on the test outcome and its accuracy, prediction of Test set is achieved.

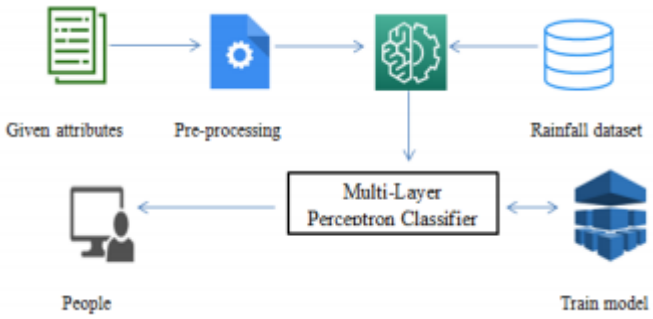

Figure 1: System Architecture

Among the various catastrophic events, floods are the most calamitous, reflecting enormous harm on human activity, foundations, agribusiness, and the financial framework. Political administrations, along these lines, feel the pressure to create solid, accurate and precise graphs identifying flood prone zones and additional arrangements for feasible and viable flood hazard controls concentrating on anticipation, preservation, and alertness. Flood forecasting systems are

of high significance for risk evaluation and extraordinary event handling in case of an emergency. Robust, precise and correct forecasting contributes profoundly to water resource handling procedures, tactical strategies, further examination, and additional expulsion designing of the same. Hence, the significance of cutting-edge frameworks for short-period and long-period forecasting of flash floods and several other water-related blunders is emphatically asserted to reduce loss. Nonetheless, the forecasting of flood indication time and affected area is basically complex because of the changing nature of the atmospheric status. Existing frameworks stick to tackle issues to forestall disastrous blunders brought about by floods. The purpose of this system is to build a model for real-time flood prediction. In our proposed system, we took the best algorithms that would work and tested them to achieve good results. This system can predict flash floods in an urban area with better efficiency and accuracy than the conventional methods which are being used at present for the same. This proposed system helps us to implement better security and surveillance by predicting a flash flood well in advance and makes us ready to be able to tackle the same efficiently.

4. Implementation

Artificial Intelligence is sub-categorized into Deep Learning. The deep learning's objective is ideally to visualize the structure of data and consequently fit that data into models that can be inferred and used. Deep learning (ML) aids the computers in the ability to learn by itself rather than through programming. The different sorts of AI models incorporate supervised, unsupervised and reinforcement learning. The first type of learning algorithm, supervised learning, consists of both the input data and its corresponding learning data label, whose labelling is done manually. On the contrary, unsupervised learning has input data, but no labels. Supervised learning algorithms primarily deal with clustering of the input data. Reinforcement algorithms interact dynamically with its surrounding environment and then learn using responses which are either positive or negative.

Figure 2: Deep learning process

In supervised algorithms, one has multiple input factors (let=xi , where i=1,2,3…..,n), a single output factor (let=y) and an algorithm for learning of the method that maps input, x, to the result, y, is f(x)=y. The purpose of the algorithm is to make the mapping function as analogous as possible so that when we have a new input data (x), the calculation will be able to predict the corresponding yield variable(y). The supervised algorithm consists of multiple methodologies for its implementation which are as follows: Support Vector Deeps (SVMs), Multi-Class Classification, Logistic Regression, Decision Trees, etc. On the other hand, unsupervised learning algorithms which do not require any administration as in the supervised model. Instead of that, the model itself is authorized to train on its own and thereafter identify the data. The unsupervised learning algorithms handle the unlabeled information. Although unsupervised learning has the ability to handle more compound problems, it is more unpredictable as compared to other algorithms.

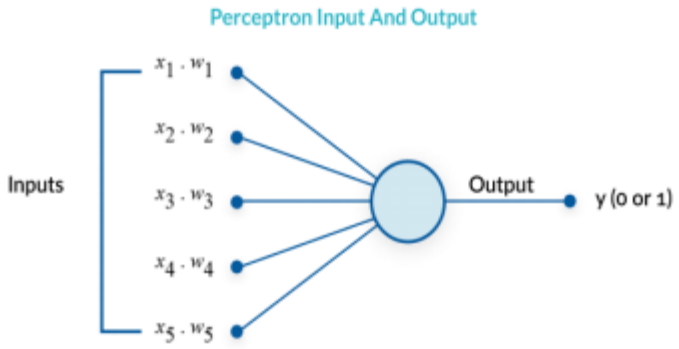

Figure 3: Perceptron input and output

Multi-layer Perceptron (MLP) belongs to the class of feed forward classifier of Artificial Neural Networks (ANN). Multi-Layer Perceptron(also called Multi-Layer Neural Network), contains one or more additional layers which are hidden layers(apart from single input and a single output layer). Whereas a single layer perceptron learns solely from the linear functions. On the other hand, a multi-layer perceptron has an added functionality to learn non–linear functions as well. There are at least 3 node layers which are as follows: output layer, input layer and hidden layer. Barring the input nodes, every other node is called a neuron which utilizes a nonlinear function for activation. The supervised learning procedure of back propagation is utilized by MLP for the purpose of training our data-set.

The modules included are as follows:

4.1. Data pre-processing: The task of pre-processing includes the alterations implemented to the data before dispensing it to the algorithm. It is a kind of preparation of data for the process. Raw data gets transformed into a clean data set using pre-processing. At whatever point the data is aggregated from different sources, it is first accumulated in a raw format. This format isn't practical with the analysis process and the end goal of the probe. To accomplish better results from the applied model in the ML (Deep Learning) system for the data should be arranged in a proper manner. Some predetermined Deep Learning models need information in a predefined format; for example, an Estimation of Random Forest algorithm does not contain values that are null or invalid. Along these lines, to implement random forest calculations, the values which are null or invalid must be taken care of or be removed from the first raw data-set.

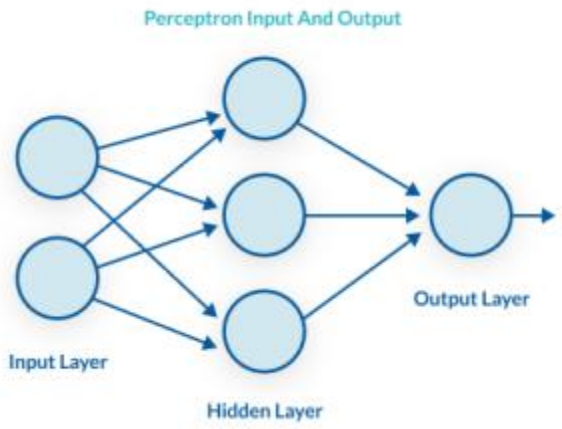

Figure 4: Multi-layer perceptron model

4.2.Outlier detection process

Many AI calculations are delicate to the distribution and range of trait values in the dataset given as input. Exceptions in input information can alter and misguide the training procedure of AI calculations attaining higher training time, less accurate designs and finally impoverished outcomes. In truth, prior to anticipatory designs being arranged to assemble data, exceptions can generate deluding imitations and hence deceitful understandings of collected information. Anomalies can alter the outline dispersion of characteristic values in illustrative measurements like the average(mean) and SD(standard deviation) and in charts, for example, scatter plot graphs and histograms, compacting the body of data. Lastly, special cases can address cases of information instances that are significant to the issue, for example, peculiarities on account of detection of fraud, misrepresentation and computer security. Outlier detection processes can

neither befit the model on the training information nor assert that the design will function accurately for legitimate data. To achieve the aforementioned, we must ensure that the design has the correct models from the data, and is not finding a tremendous measure of clamor. Cross-approval is where we develop the model using the subset of the data-set and thereafter, evaluate using the correlative subset of the given data-set.

4.3.Data Visualization

Visualization of data is a significant ability in applied stats and AI. Applied stats do focus on large-scale depictions and assessment of data. Data recognition provides a noteworthy array of instruments for getting a subjective understanding of information. This can be useful when investigating and understanding a dataset and can help with recognizing designs or patterns in data, degenerate information, anomalies and substantially more. With a little domain intelligence, information perceptions may be utilized to direct and show key connections in plots and outlines that are more instinctive and partners than the proportions of association or significance. Information representation and exploratory information examination are entire fields themselves and it will suggest a more profound plunge into a portion of the books referenced towards the end.

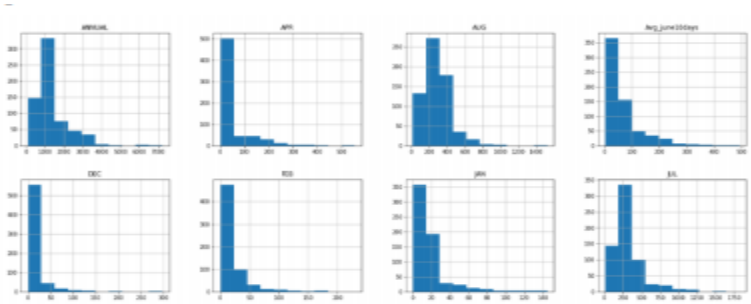

Figure 5. Rainfall distribution

Figure 6. Stages of process

In some cases, data does not bode well until it can be represented using visual forms or structures, for example, using outlines, charts and plots. Having the option to rapidly envision information samples is a significant ability both in applied stats and in applied deep learning. It will find the numerous kinds of plots that one should make note of while visualizing information in Python and how to utilize them to more readily understand one's own information.

5. Results and Discussion

Upon running the program, the dataset can be plotted using the Matplotlib library and can be used to depict the monthly distribution of rainfall over a district of the Indian subcontinent. It helps to observe the months with maximum and minimum rainfall annually. The framework utilizes the normal precipitation of a third day of the month with moderate measures of precipitation received on a yearly premise. It can be improved by adding the effects of drainage and water logging systems and their efficiency in an urban area. The system can be improvised by adding a graphical user interface to make it user-friendly and a real-time application.

```
Classification report of MLP Classifier Results:

              precision    recall  f1-score   support

           0       0.97      1.00      0.99       185
           1       1.00      0.38      0.55         8

    accuracy                           0.97       193
   macro avg       0.99      0.69      0.77       193
weighted avg       0.97      0.97      0.97       193

Accuracy result of MLP Classifier is: 97.40932642487047

Confusion Matrix result of MLP Classifier is:
 [[185   0]
 [  5   3]]

Sensitivity :  1.0

Specificity :  0.375
```

Figure 7: MLP Classifier results

Deep Learning provides us with a platform to inhibit the system's ability to automatically learn and improve without being explicitly programmed. This process ensures that any human error is omitted and a fool-proof mechanism is provided to get the desired results correctly over and over again.This project is based on the dataset of annual rainfall received in India over the last few years. It predicts the chances of occurrence of flash floods in an urban area of the society and helps prevent such disasters. The results provided by MLP classifier are the most accurate and

provide better results in this field. The process of instant flood forecasting can be improvised in the time to come and help in enhancing the department for disaster management for the safety of humankind.

6. Conclusion

The proposed model will help us get rid of the obsolete model of manual entries and automation will help speed up the work. This model will help in recognizing and controlling flash floods in an urban area and also set risk management standards, based on the rainfall received in that region of the nation on a yearly basis. It lays focus on saving costs by being proactive instead of being reactive. It helps in the depreciation of the harm related to human survival, and decline in the property damage associated with floods

Table 1.Comparison of results

S. No.	Algorithm used	Accuracy	Sensitivity	Specificity
1.	Logistic Regression	95.337	0.96	0.75
2.	Support Vector Classifier	95.855	1.0	0.0
3.	K-NearestNeighbour	95.855	0.98	0.375
4.	MLP Classifier	97.41	1.0	0.375

The future scope of this project is: Disaster management wants to automate the process of detection of flash floods in an urban area at real-time. To automate this process by displaying results of flood prediction in a web application or a desktop application. To optimize the work done by using and implementing an Artificial Intelligence environment.

References

[1] Mohammed Khalaf, Abir Jaafar Hussain, Dhiya Al-Jumeily, Thar Baker, Robert Keight, Paulo Lisboa, Paul Fergus, Ala S. Al Kafri, "A Data Science Methodology Based on Deep Learning Algorithms for Flood Severity Prediction", 2018 IEEE Congress on Evolutionary Computation (CEC), pp. 230-237, July 9, Liverpool john moors university, United Kingdom.

[2] Joe Marlou A. Opella, Alexander A. Hernandez, "Developing a Flood Risk Assessment Using Support Vector Deep and Convolutional Neural Network: A Conceptual Framework", 2019 IEEE 15th International Colloquium on Signal Processing & its Applications (CSPA 2019), pp. 260-265, 8 -9 March 2019, Penang, Malaysia.

[3] Amitkumar B. Ranit, Dr. P.V. Durge, "Different Techniques of Flood Forecasting and their Applications", 2018 3rd IEEE International Conference on Research in Intelligent and Computing in Engineering , August 22nd, Universidad Don Bosco (UDB), El Salvador.

[4] Salami Ifedapo Abdullahi, Mohamed HadiHabaebi, and Noreha Abdul Malik, "Flood Disaster Warning System on the go", 2018 IEEE 7th International Conference on Computer and Communication Engineering (ICCCE), 19th September, Kuala Lumpur, Malaysia.

[5] Sara Saravi, Roy Kalawsky, Demetrios Joannou, Monica Rivas Casado, Guangtao Fu and Fanlin Meng, "Use of Artificial Intelligence to Improve Resilience and Preparedness Against Adverse Flood Events", Volume 11, Issue 5, 2019, Article No. 973, 9 May 2019, Molecular Diversity Preservation International, Switzerland.

[6] Faraz Ahmad, Om Ashish Mishra, ShivamBhagwani, Jabanjalin Hilda J, "A Model for Empirical Earthquake Prediction and Analysis in a Data Intensive Environment", International Journal of Innovative Technology and Exploring Engineering, ISSN: 2278-3075, Volume-8, Issue-6S3, April 2019.

[7] Caldera, H. J. &Wirasinghe, S.C., 2014. "Analysis and Classification of Volcanic Eruptions" In R. R. Rapp & W. Harland, eds. The 10th International Conference of the International Institute for Infrastructure Resilience and Reconstruction (I3R2). West Lafayette, Indiana: Purdue University., pp. 20–22, May 2014.

[8] de Boer, J., "Definition and classification of disasters: Introduction of a disaster severity scale." The Journal of Emergency Medicine, 8(5):591–595, 1990. [9] Below, R., Wirtz, A. & GUHA-SAPIR, D., 2009. "Disaster Category Classification and peril Terminology for Operational Purposes." Centre for Research on the Epidemiology of Disasters (CRED) and Munich Reinsurance Company (Munich RE), October 2009.

[10] Wirasinghe, S.C., Caldera, H. J., Durage, S. W., &Ruwanpura, J. Y. "Preliminary Analysis and Classification of Natural Disasters." In P. H. Barnes & A. Goonetilleke, eds. The 9th Annual International Conference of the International Institute for Infrastructure Renewal and Reconstruction. Brisbane, Queensland, Australia: Queensland University of Technology, p. 11, 2003.

[11] Hristidis, V., Chen, S.-C., Li, T., Luis, S., & Deng, Y. "Survey of data management and analysis in disaster situations." Journal of Systems and Software, 83(10):1701–1714, 2010

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