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Flood Estimation By Using MLP Classifier of a Neural Network Model

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Abstract - *Floods are the most disruptive natural events, yet engineering them is very difficult. The development of flood prediction models has led to risk avoidance, policy suggestions, a reduction in human life loss, and a reduction in property destruction, both of which are correlated with floods. During the last two decades, neural network approaches have made significant contributions to the development of predictions by simulating the dynamic mathematical expressions of physical flood processes. This has resulted in improved efficiency and cost-effective solutions. Neural network-based approaches are used to avoid this issue and forecast floods using rainfall data. The inquiry process commences.*

Key Words: **Python, Pre-treatment, Dataset, Multi-Layer Perceptron, Confusion Matrix, Neural Network.**

1.INTRODUCTION

Water logging is most likely to happen in urban areas along a sub-pass or in a low-lying environment. Water accumulates in a short period of time in flood-prone areas. Water-logging is caused by a combination of factors including relative elevation, surface runoff, and inadequate water passage to drainage. As a consequence, flood forecasting is critical in these areas.

2. OVERVIEW

Machine learning is the method of predicting the future based on historical evidence. Machine learning (ML) [11] is an artificial intelligence (AI) technique that allows computers to learn without having to be specifically programmed. Machine learning focuses on the development of computer programs that can adapt when exposed to new data, as well as the fundamentals of machine learning, such as the implementation of a simple machine learning algorithm.

Specialized algorithms are used in the training and prediction process. It feeds the training data to an algorithm, which uses the training data to make predictions on new test data. Machine learning can be classified into three groups. There are three ways of learning: supervised learning, unsupervised learning, and reinforcement learning.

Supervised Machine Learning algorithms use methods such as logistic regression, multi-class classification, Decision Trees, and support vector machines, among others. Classification problems are a subset of supervised learning problems. Unsupervised learning is a machine learning technique in which no guidance is needed and the model is left to explore knowledge on its own. Clustering, anomaly identification, association mining, and latent variable models are some of the applications of unsupervised machine learning techniques.

3. SCOPE

The aim of this project is to look at rainfall datasets from India in order to identify flash floods. It is more difficult to identify flash-floods. In order to reduce the loss of human life and property damage caused by flooding. This method of prediction decreases meteorological efforts while increasing the possibility of predicting the occurrence of a flash flood.

4.LITERATURE SURVEY

The use of synthetic aperture radar (SAR) data in operational flood management services is now well known. However, due to the small area that can be observed from a SAR image and the need to program SAR acquisitions in advance, certain activities might be missed. To address these issues, it is possible to set up a framework that can activate SAR acquisitions based on flood forecasts and make use of the numerous satellite SAR sensors that are currently operational.

A prototype of this type of system was set up and preliminarily tested on behalf of the Italian Civil Protection Department (DPC) to track the Po River (Northern Italy) flood in November 2014, using COSMO-Sky Med (CSK) and Sentinel-1 (S-1) data. This paper introduces the prototype system and explains in detail the system's near real-time flood mapping algorithm. The algorithm was originally designed to identify CSK images, but it has been adapted to work with S-1 data as well

This paper also analyses the main outcomes of the Po River flood monitoring, emphasizing the value of radar acquisitions being programmed in advance. The results show the dependability of the model's flood forecasts as well as the accuracy of the flood mapping algorithm. It is also

demonstrated that when CSK and S-1 data are collected concurrently, their combined use enables the interpretation of certain ambiguous radar signatures in agricultural areas.

5. EXISTING SYSTEM

Flood forecasting techniques that are currently in use are both costly and difficult. The forecasting of weather and rainfall is a critical component of flood prediction. Weather forecasting entails physics and differential equation simulations. Radar and satellite imagery are used to predict rainfall. A Doppler weather radar is used to track the motion of rain droplets and to locate precipitation.

Dedicated weather satellites provide images from which rainfall information can be deduced, and the aim for short-term flash flood prediction in urban areas is to develop a computational approach that integrates flood-influencing factors and uses the power of machine learning techniques to estimate floods ahead of time. Rapid population growth, climate change, and heavy rainfall have all contributed to an increase in the number of urban flash floods.

It is important to forecast the occurrence of a flood so that the effects can be diminished. An urban flash flood happens in an urban area in a very short period of time, as the name implies. Short-term forecasting or now casting is used to predict the very near future incident in order to reduce the effects of these incidents. Current weather conditions are analyzed using traditional methods such as radar, satellite imagery, and calculations involving complex mathematical equations in orthodox flood forecasting methods.

However, recent advances in Digital Technology (ICT) and Machine Learning (ML) have allowed us to examine this hydrological issue from a new angle. The aim is to construct a theoretical model that takes into account the parameters that trigger an urban flash flood and can predict the event ahead of schedule.

6.DRAWBACKS

To put in place a model for an urban environment in which short-term forecasting of a flood and its dynamic scenario involving several cells is imagined, as well as a realistic real-world scenario.

It cannot thus improve the regularity of rainfall data and achieve more reliable flash flood prediction performance.

7.PROPOSED SYSTEM

Heavy rainfall is one of the most destructive natural disasters, taking many lives and causing significant damage. Over the years, different aspects of floods such as river floods, urban floods, tidal floods, and flash floods have been observed.

A flash flood is a direct result of heavy rain that falls in a short period of time. This form of the flood is common in urban areas where the underlying land cannot cope with or drain excess water away easily enough through the drainage system and draining canals. In recent years, we have witnessed the devastation caused by floods in cities such as Mumbai, Chennai, and others. The key causes are poor urban planning, unreliable and delayed forecasts, and an insufficient flood mitigation scheme. A simplified dataset is developed from the given dataset and then used to extract patterns and findings with maximum accuracy.

Three steps are completed in this section: the report will load in data, check the data, trim the data, and clean the provided dataset for review. Make certain that the procedures are carefully documented and that cleaning decisions are justified. The data collection gathered for predicting provided data is split into two groups: training and testing. In general, 7:3 ratios are often used to separate the Training and Test sets. The Data Model generated with the Multi-Layer Perceptron Classifier will be added to the training set, and the Test set will be projected based on the accuracy of the test results.

For flood prediction, ANN models are often trained with a BPNN. The MLP is a type of FFNN that utilizes BP supervised learning to train a network of interconnected nodes through multiple layers.MLP is distinguished by nonlinear activation and a large number of layers. Because of these properties, these models were commonly used in flood prediction and other complex hydrogeological models. MLP models were found to be more powerful but more difficult to optimize.

8.ADVANTAGES

The aim of these reports is to investigate the suitability of machine learning strategies for air quality forecasting in operating conditions. Finally, it addresses certain future research problems, challenges, and needs. ML is a subset of artificial intelligence (AI) that is used to instill regularities and patterns, allowing for simpler deployment with low computing costs, as well as easy preparation, validation, monitoring, and assessment, with good efficiency compared to physical models and comparatively less difficulty.

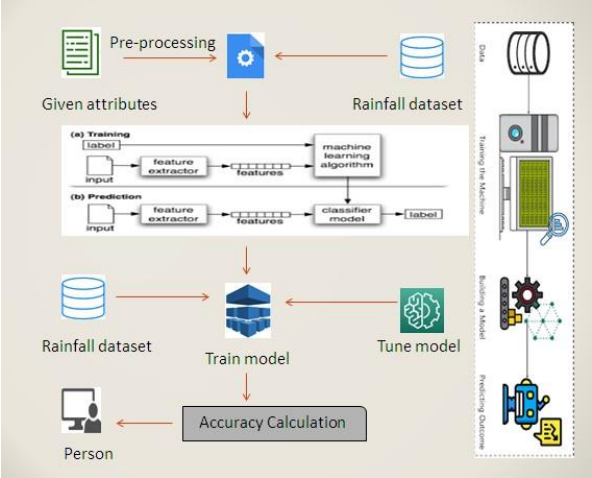


Fig .1

9. REQUIREMENT ANALYSIS AND SPECIFICATION

9.1.INPUT REQUIREMENTS:

The level of rainfall estimated in regions where flooding must be expected.

9.2.OUTPUT REQUIREMENTS:

A Graphic User Interface (GUI) containing a column for each state and district in India, as well as the number threshold value. The conclusion can be drawn accurately with all of these results.

9.3.FUNCTIONAL REQUIREMENTS:

The software specifications design is a technical specification of the software product's requirements. It is the first step in the method of specifications review. It enumerates the parameters of a certain software framework. The special libraries such as SK-learn, pandas, NumPy, matplotlib, and seaborn are detailed below.

9.4.HARDWARE ENVIRONMENT:

1. Processor: i3/ i5
2. Hard disk: minimum 400 GB
3. RAM: minimum 6 GB

9.5.SOFTWARE ENVIRONMENT:

Requirement

1. Operating System: Windows
2. Tool: Anaconda with Jupyter Notebook.

10. MODULE DESIGN SPECIFICATION

10.1.DATA VALIDATION AND PRE-PROCESSING TECHNIQUE:

Data validation assists in determining the error rate of a Machine Learning (ML) algorithm by identifying missing and redundant values. It analyses the given data set and assists in the perception of the data and its properties. This expertise will aid us in determining the algorithm used to construct the model.

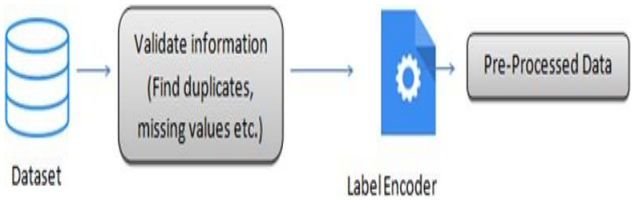


Fig .2

10.2.CREATE A PREDICTED VARIABLE BY RAINFALL RANGE:

The dataset is trained to have an approximate model skill as well as techniques for maximizing the use of validity and test datasets when testing our models. To properly interpret our statistics, we must visualize it, either by charting time series data with line plots and categorical quantities with bar charts.

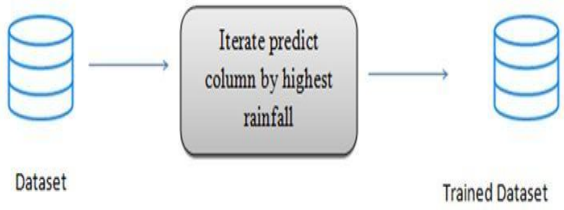


Fig .3

10.3.PERFORMANCE MEASUREMENTS OF ML ALGORITHMS:

To assess results, thus shall ensure that our model extracted the right patterns from the data and that it is not generating too much noise. Outliers will distort the summary distribution of attribute values in descriptive statistics, based on incorrect representations. That being said, in cross-validation, our model is trained on a subset of the data set and then evaluated on a complementary subset of the data set.

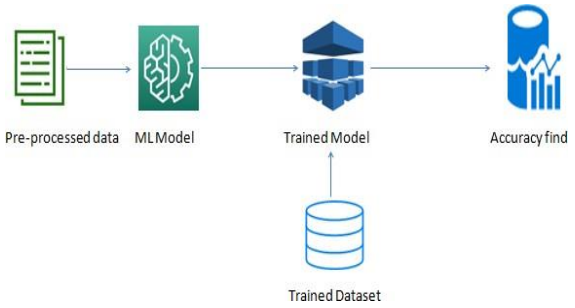


Fig .4

10.4.PERFORMANCE MEASUREMENTS OF MLP CLASSIFIER NEURAL NETWORK:

One or more secret layers are present in a Multi-Layer Perceptron or Multi-Layer Neural Network. An MLP will have at least three-node layers: an input layer, a hidden layer, and an output layer. MLP differs from linear perceptron in that it has several layers and non-linear activation. It is capable of separating data that can only be differentiated linearly.Except perhaps the input nodes, each node is a neuron with a nonlinear activation function.

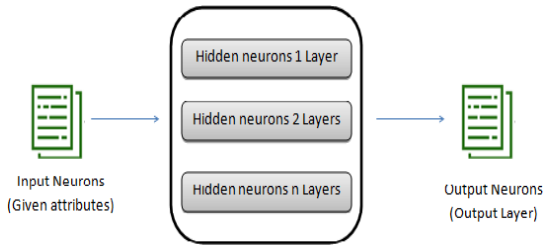


Fig .5

10.5.GUI BASED PREDICTION OF FLOOD BY RAINFALL:

The Tkinter module (Python interface to the Tk GUI toolkit) is the standard Python Tkinter GUI toolkit. Python, when combined with Tkinter, offers a quick and simple way to construct graphical user interface (GUI) applications. Tkinter will be used to ensure the confidentiality of both consumers and accountants.

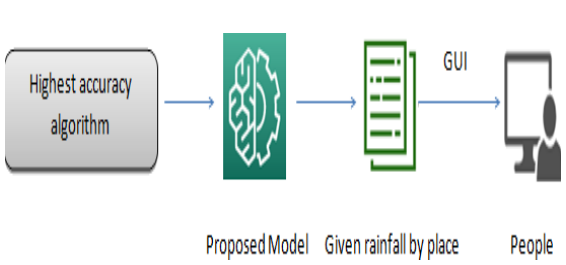


Fig .6

11. PROGRAM DESIGN LANGUAGE

11.1.LOGISTIC REGRESSION

Logistic regression is a classification algorithm that uses supervised learning to estimate the likelihood of a target variable. Since the existence of the goal or dependent variable is dichotomous, there are really only two possible classes. Where the dependent variable (target) is categorical, logistic regression is used. For instance, to decide whether an email is a spam (1) or not (0).

11.2.SUPPORT VECTOR MACHINES

Help vector machines are maximum-margin classifiers, which means that we locate the hyper-plane with the greatest perpendicular distance between it and the nearest samples on either side. How to decipher the various names for support vector machines. When a training set is offered, an SVM training algorithm is used. It is a non-probabilistic binary linear classifier that constructs a model that assigns new examples to the categories.

11.3.K-NEAREST NEIGHBOR

It is a supervised classification algorithm that takes a large number of classified points and uses them to learn how to mark new points. The performance of k-NN classification is a class membership. The k-nearest neighboring algorithm (k-NN) is a non-parametric classification and regression tool. The k-NN algorithm is unique in that it is adaptive to the local structure of the data.

11.4.MULTILAYER PERCEPTRON:

The term MLP is used ambiguously, often to refer to some feed-forward ANN and sometimes to networks consisting of several layers of perceptron's (with threshold activation). A multilayer perceptron (MLP) is a type of artificial neural network that uses feed-forward (ANN). Multilayer perceptrons are often referred to as neural networks, particularly when only one hidden layer is present. One or more secret layers are present in a Multi-Layer Perceptron or Multi-Layer Neural Network (apart from one input and one output layer). A single-layer perceptron can only learn

linear functions, while a multi-layer perceptron can learn non-linear functions as well

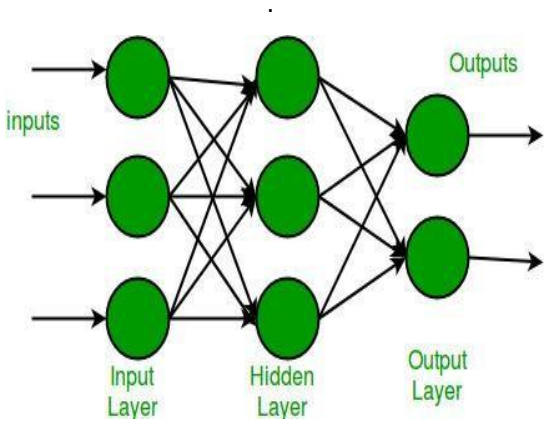


Fig .7

An MLP has at least three-node layers: an input layer, a hidden layer, and an output layer. Each node, except for the input nodes, is a neuron with a nonlinear activation function. For instruction, MLP employs a supervised learning method known as backpropagation. MLP is distinguished from linear perceptrons by its many layers and non-linear activation. It is capable of separating data that is not linearly separable. A perceptron is a very basic computer for learning. It may take a few inputs, each with a weight to indicate how significant it is, and produce an output decision of "0" or "1.

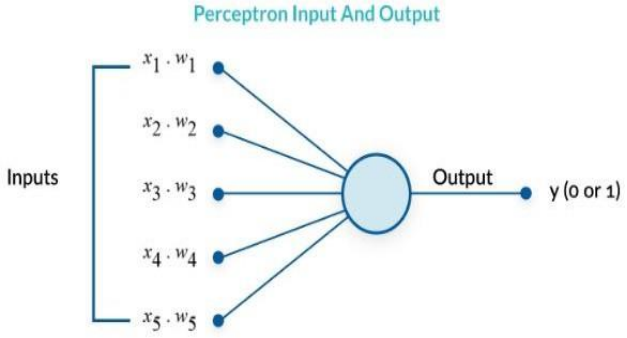


Fig .8

When paired with a significant number of other perceptrons, it forms an artificial neural network. Provided adequate training data and computational power, a neural network will potentially address any query. A multilayer perceptron (MLP) is a perceptron that collaborates with other perceptrons stacked in several layers to solve complex problems. The diagram below depicts a three-layered MLP. Each perceptron in the first layer on the left (the input layer) sends its output to all perceptrons in the second layer (the secret layer), and all perceptrons in the second layer send their output to the final layer on the right (the output layer).

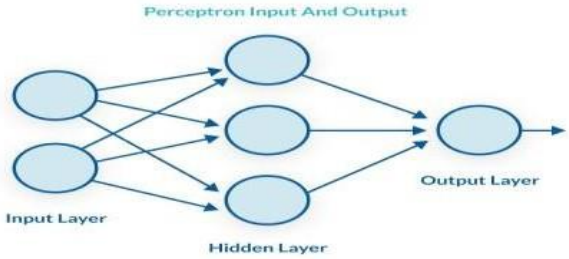


Fig . 9

Each perceptron sends several signals, one to each perceptron in the subsequent sheet. The perceptron employs various weights for each signal.

Per line in the diagram above reflects a separate output from a perceptron in one layer to the next. Since each layer can have a huge number of perceptrons and several layers, the multilayer perceptron can easily become a very complicated device. The multilayer perceptron is also recognized as a neural network.

A Non-Deep or Shallow Neural Network is a three-layer MLP, such as the one seen in the diagram above. A Deep Neural Network is an MLP of four or more layers. One distinction between an MLP and a neural network is that the decision function in a classic perceptron is a phase function, and the output is binary. Other activation functions that result in outputs with real values, typically between 0 and 1 or between -1 and 1, can be used in neural networks that This enables probability-based forecasts or the nomenclature of objects into several labels.

12. WORKING

1. Inputs are taken, multiplied with their weights, and calculates their sum: The weights allow the perceptron to gauge the relative importance of every one of the outputs. Neural network algorithms are learned by discovering better and better weights that result in a more accurate prediction. There are so many algorithms used to fine-tune the weights, the most common is called backpropagation.
2. Bias factor is added, the number 1 multiplied by a weight: This is a technical step that makes it possible to move the activation function curve up and down, or left and right on the number graph. fine-tune of the numeric output of the perception is possible.
3. Feeds the sum through the activation function: The activation function maps the input values to the specified output values. For example, input values can be in range 1 and 100, and outputs can be in range 0 or 1. The activation function also helps the perceptron to find out, when it's a part of a multilayer perceptron (MLP). Certain properties of the activation function, especially its non-linear nature, make it possible to train complex neural networks.

4. The result is the perceptron output: In a multilayer perceptron, the output of one layer's perceptrons is the input of the next layer. The perceptron output is a classification decision. The output of the final perceptrons is the "output layer", there is the final prediction of the perceptron learning model.

13. PERFORMANCE ANALYSIS

13.1.PARAMETER AND ACCURACY CALCULATIONS:

1. True Positive: It is an outcome where the model correctly predicts the positive class.
2. True Negative: It is an outcome where the model correctly predicts the negative class.
3. False Positive: It is an outcome where the model incorrectly predicts the positive class.
4. False Negative: It is an outcome where the model incorrectly predicts the negative class.

14. SENSITIVITY

Sensitiveness is a measurement of the rate of effective positive cases that got called positive (or true positive). Sensitivity is also named Recall. This implies that there will be another magnitude of effective positive cases, which would get called inaccurately as negative (and, so, could moreover be named as the false negative). This can also be depicted in the form of a false negative rate. The total sensitivity and false-negative rate would rank 1.

The developed value of sensitivity would denote the developed value of the true positive and the inferior value of the false negative. The inferior value of acuteness would mean the inferior value of the true positive and the developed value of the false negative.

Explicitness is defined as the proportion of effective negatives, which got called the negative (or true negative). This proportion could also be called a false positive rate. This implies that there will be another proportion of effective negative, which got called positive and could be named as false yeses. The sum of explicitness and false positive rate would always be Mathematically, explicitness can be calculated as the following

Explicitness = (True Negative)- (True Negative + False Positive). The improved value of particularity would mean an improved value of true negative and lower false-positive rate. The lower value of particularity would mean a lower value of the true negative and an improved value of false positive.

The proportion of positive prognostications that are actually correct. (When When the model predicts neglect how hourly is correct?)

Precision = True Positive / (True Positive + False Positive)

Precision is the rate of fittingly prognosticated positive conformities to the total prognosticated positive conformities. The question that this metric answer is of all passengers that labeled as survived, how multiplex actually survived? High perfection relates to the low false-positive rate. We've got0.788 perfection which is good.

Recall the proportion of positive observed values fittingly prognosticated. (The proportion of real defaulters that the model will fittingly prognosticate)

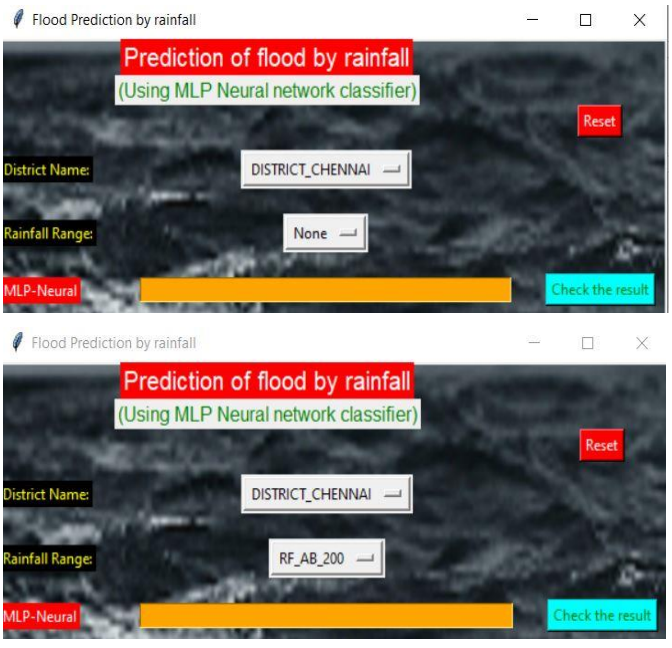
Recall = True Positive / (True Positive + False Negative)

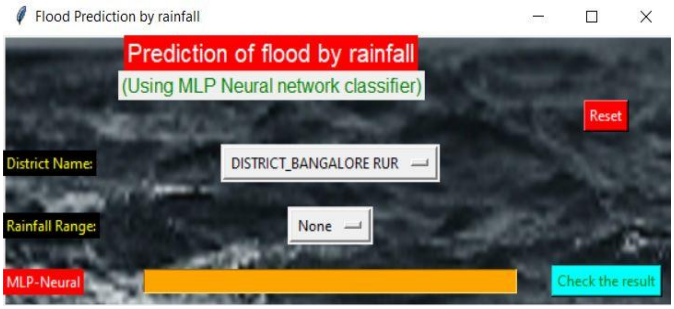
Recall (Perceptiveness)-Recall is the rate of fittingly prognosticated positive observances to all observances in very class- yea.

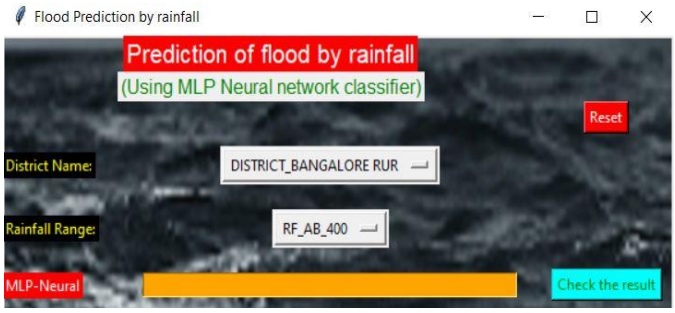
F1 Score is the weighted standard of Precision and Recall. So, this score takes both false vetoes and false negatives into account. Fundamentally it isn't as easy to understand as veracity, but F1 is normally more useful than veracity, especially if you have an uneven class distribution. Veracity works best if false vetoes and false negatives have such as cost.However, it-s better to look at both Precision

15 REPORT

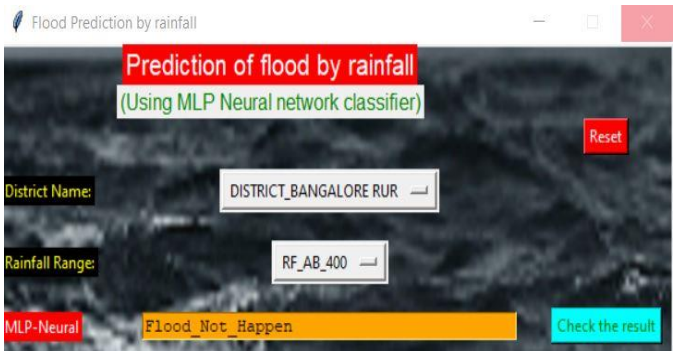
15.1.INPUT:

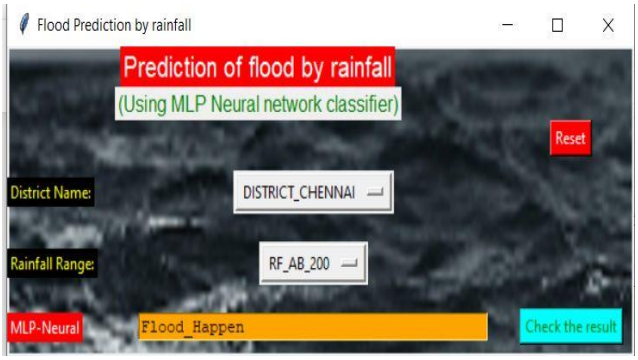






15.2.OUTPUT





16.CONCLUSION

There were limited attempts in the forecasting of Flash Flood. Radar was the only alternative used for the forecasting of Flood. So, the main aim of this system is to deliver forecasting using neural networks. For which the coherent process was capitalized which began from data drawing and reclaiming, missing value, exploratory analysis, model structure, and evaluation. Various modules were fabricated denoting the use of each of the coherent processes made. eventually, we forecast flash flood tide using different machine learning algorithms each proving characteristic results. This signifies a vehement model for the forecasting of flash flood tide using Machine Learning. Among them, the sporty result was delivered by multi-Layer Perceptron Classifier algorithm with an accurateness of93.33-. This brings some of the following perceptiveness about flood tide forecasting.

16.1.FUTURE WORK

Disaster management wants to automate the detecting of the flash flood that happened or not from the eligibility process (real-time).

1. To provide smartphone notifications related to flood forecasting.

2. To automate this process by showing the prediction results in web or desktop applications.

3. To add various other parameters to improve efficiency.

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