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Flood Susceptibilty Prediction using LSTM Algorithm

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Abstract
This Floods are one of the most frequent and severe natural disasters. Especially in India, where about 60% of the flood damage occurs due to river floods and 40% due to heavy rainfalls and cyclones. The main reasons for these intense flooding's are severe deforestation, development, and infrastructure in flood-prone areas, impermeable surfaces, and heavy rainfall. The impact of flooding includes loss of human life, damage to property, destruction of crops, loss of livestock, and deterioration of health conditions owing to waterborne diseases. This project helps in predicting the susceptibility of flooding of a particular area based on not only on the rainfall level given by the meteorological department but also based on the data such as previous rainfall levels, River flow. The data obtained are trained by using special recurrent network algorithm called LSTM (Long Short-Term Memory networks).
Keywords: Flood Prediction, LSTM, Machine Learning, Tensor flow etc.

I. Introduction

The objective of this project is to map the flood susceptibility to a particular location using a special recurrent neural network called Long Short Term memory. Primarily the projects presents the current scenario of floods in India presenting data about the locations which are above normal flood level, which are under severe flooded conditions, and the locations which are under extremely flooded conditions. Then based on the location chosen by the user from a particular state in India, The appropriate data for that particular location is fetched such as the average rainfall level and water level. This data is then analysed by the machine Learning model which is trained using the LSTM (Long Short Term memory

model) algorithm.The model is trained using the parameters such as real time rainfall data measured in mm, Water flow level of the last 50 years. The output of this model would be predict the locations precisely where the flooding might occur based on the flow and will help in alerting the authorities prior to the occurrence of any flash floods.

II.Related Work

The author [1] considers the data of the preceding hours to predict the rainfall runoff of the next few hours using LSTM algorithm.Back Propagation Network [2] predicts the stream flow for next 6 hours by using the

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data gathered from previous

years.Based on the geographical images[3] obtained from the satellite and using decision,the author predicts the rainfall.

The FR model[4] shows more influence classes related to residential areas ,water bodies and rainfall for preparing susceptibility map of flood.The author paper proposes a flood prediction [5] benchmark dataset for future applications in machine learning as well as a scalable approach to forecasting river stage for individual survey points on rivers.,The EPS model[6] aimed at limiting the range of the uncertainties in runoff simulations and flood prediction.

III. Proposed Method

In proposed system we identify the key parameters such as the current water level and the rainfall level and use it for mapping the occurrence of a flood using a multivariate LSTM forecast stacked model. Other parameters like forest cover and ground height level led to inconsequential results due to which those parameters were not used. On a comparative Performance analysis of different methods for predicting floods using Orange a datamining and data analytics tool. The F1 scores obtained for the logistic regression algorithm is 97.6% and for that of support, vector machine is 97.2% and for that of Neural Network is 98.1%. In a traditional neural network, we assume that each input is independent of each other this is overcome by using RNNs, which are recurrent and depend on previous computations. But RNNs are not absolutely capable of handling “long-term dependencies”. So we use LSTM networks since they are well-suited to classifying, processing and making predictions based on time series data, since there can be lags of unknown duration between important events in a time series

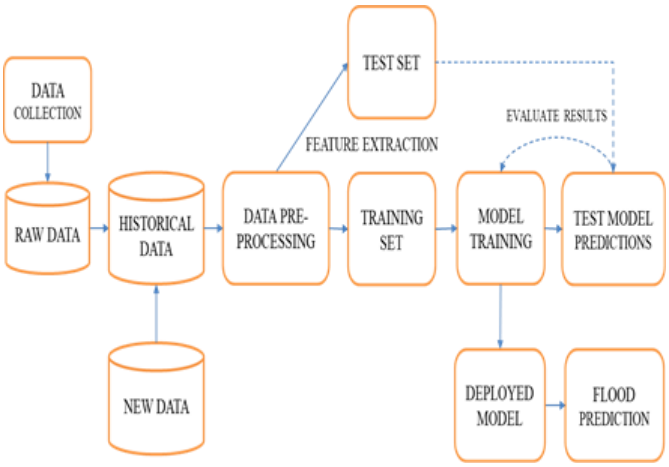

Fig:1 Data Exploration and Modelling Architecture Block Diagram

1. LSTM Model:

In our Model, we use 12 time steps for each feature as input. The model has four LSTM hidden layer to extract data from the sequence and finally we use dense layer as output for making flood predictions.

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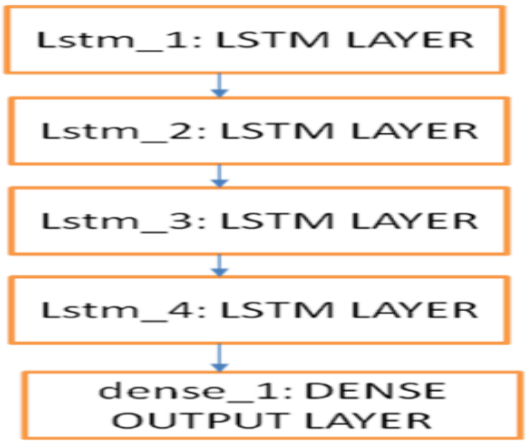

Fig:2 LSTM Dense Layer Architechture

2. MODULES:

Our Proposed work consist of 3 modules:

- Data Pre-processing
- Training and Testing
- User Interface

2.1. Data Pre-processing 2.1.1.Data Collection

Various meteorological and hydrological data are collected such as average district rainfall(in mm) monthly, seasonal and annual ,Lake capacities
,Dam capacities ,Forest cover, Flow intensity of river and Precipitation data are collected as excel or csv files**.**

2.1.2. Data Cleaning

The raw data obtained further classified and labelled based on the required parameters and noise removal operations are performed. Noise removal operations such as removal of duplicates extra spaces blank cells,conversion of numbers stored as text into numbers and into proper case such as upper case or lower case.

2.1.3. Data Preprocessing

This step helps in dealing with missing data by using a class called imputer from Scikit learn pre- processing. In this step we also split the dataset into training set and testing set. Also in this step we perform the feature scaling or feature standardization problems which is used to limit the range of the variable or to handle a relatively large variable when compared to other variables.

2.2. Training and Testing:

The LSTM Network is trained using 75% of the preprocessed data and the rest is used for testing the model. Our model is trained and tested using the datasets such as the rainfall and water level (measured in mm). ADAM optimizer is used to train the datasets that is a combination of both ADAgrad and RMSprop. ADAgrad uses different learning rates for every datas and every timestep. RMSprop is used to normalize the gradients.ADAM provides more efficiency, requires less memory requirements and is used for problems with

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very noisy gradients and suited for problems that are large in terms of data or parameters. Based on the given input the output changes and makes predictions. The model uses 800 epochs to train the datasets, each LSTM layer is fitted using 600 neurons, and second layer uses 400 neurons followed by 200 and 100 neurons proceeding next with dense layer. Based on the input given by the user project presents the area which are affected by flood and the locations, which are affected by severe flood. LSTM network would consist of the required number of time steps, which would give a better performance, A time step is nothing but a lagged observation which would help in improving the performance of the model. The output of the data is used to identify the severity of the occurrence of the flood and prior to its occurrence.

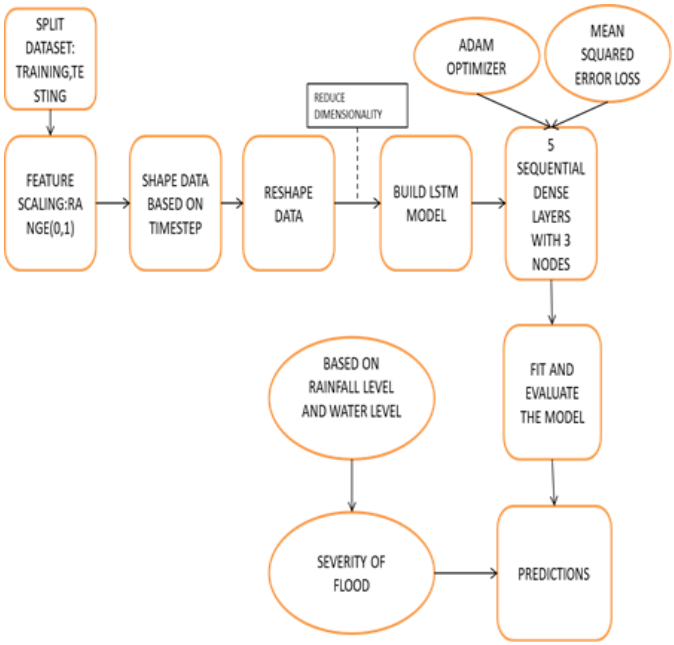

Fig:3 Overall Workflow for Flood Prediction

2.3. User Interface:

To interact with the user, we created an user interface to get the input details from the user. After getting the waterfall level and the rainfall level the trained model predicts the flood based on the user inputs and the predicted output is displayed on the screen.

2.3.1. Uploading the image files:

To make the user interface page with flood related details. We have included the graphs, which are obtained by running the code and those images, and details are included in the page which is going to interact with the user.

2.3.2. Getting the input parameters:

The User interface page ask the user to enter the rainfall level and the waterfall level from the user. The rainfall level must be got in millimetres and the waterfall values must be in millimetres. The input data are passed to the python code environment in jupyternotebook, then the data's are tested using the trained datasets.

2.3.3. Predicting the Flood

Based on the input given by the user and the trained datasets the lstm algorithm predicts whether the flood occurs or not using the past rainfall and waterfall datas .The output is shown in the new page like Flood(if

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flood occurs) or No Flood(if no possibility of flood).

IV.Experimental Results Visual Code Studio:

Visual Studio Code is a lightweight but powerful source code editor, which runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, Typescript and Node.js and has a rich ecosystem of extensions for other languages (such as C++, C#, Java, Python, PHP, Go) and runtimes (such as .NET and Unity). Visual studio code is also called as VS code.

Flask:

the flood not occurred .The Flask can be installed using the pip install command.

Flask Run Command:

```
Flask run
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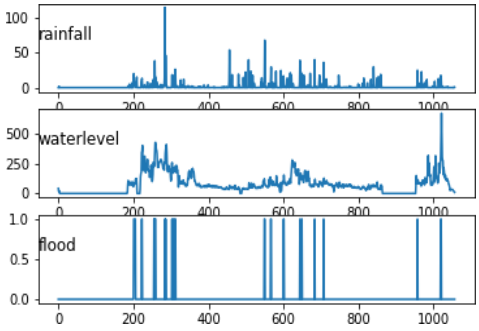

Fig:4.Depiction of rainfall data

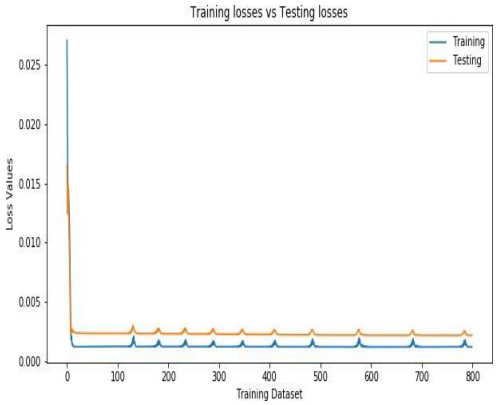

Fig:5 Losses of training and testing data to indicate it is a good fit model

Flask is a web application framework in python .Using the Html and Css codes it makes an URL which is excecuted to get the User Interface then the user can give the input and can see the output result as whether the flood is predicted or

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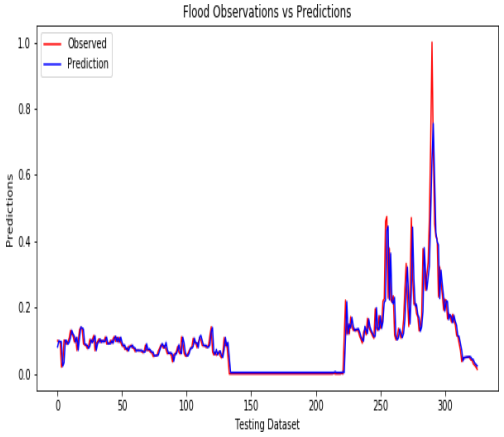

Fig:6 Comparison of Predictions and original output of testing datasets

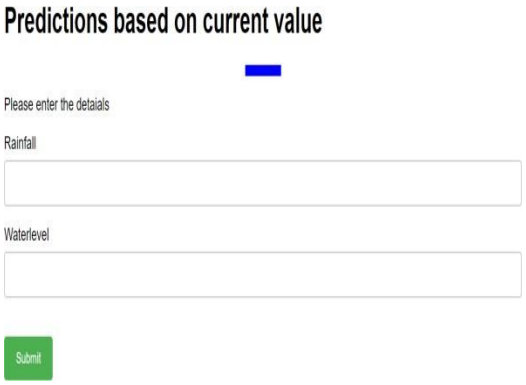

Fig:7 User Interface (using Flask)

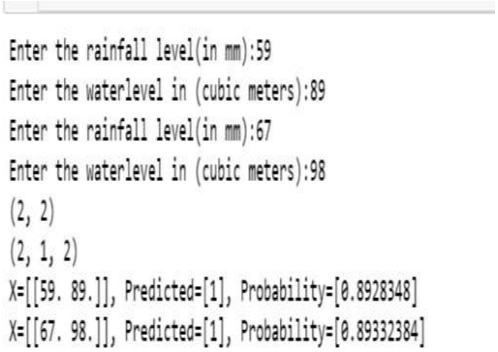

Fig:8 Input and Output

V.CONCLUSION

Our project finally concludes the flood prediction for a particular state by using the data such as the previous year rainfall and the waterfall levels where these parameters are trained and tested using the LSTM model. This model contributes the best probability rate when compared with other existing algorithms. Hence, our

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project identifies the area which is affected by flood and helps to inform or give warning to the authorities before the flash flood occurs

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