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Comparison of the Proposed Rainfall Prediction Model Designed using Data Mining Techniques with the Existing Rainfall Prediction Methods

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Abstract: ***Weather prediction is a very old practice and people are doing predictions about weather much before the discovery of the weather measuring instrument. In ancient times, people give weather predictions by observing the sky for a long time and patterns of the stars at night. Things are a bit different now. People more relay on the past trends and patterns followed by the weather parameters. Data mining and machine leaning is used to analysis the historical weather trends by analyzing weather data using various Data mining techniques. In this paper three rainfall prediction model based on data mining techniques are proposed and compared with the other rainfall prediction model. The comparison has been done on the basis of accuracy, precision, Recall and RMSE. The proposed models are based on ensemble methods such as bagging, boosting, and stacking. Ensemble methods are used to enhance the overall performance and accuracy of the prediction. In both bagging and boosting based proposed rainfall prediction models, artificial neural network is used as a base leaner and daily weather data from the year 1988 to 2022 is used. In stacking based proposed rainfall prediction model, random forest, Logistic regression, and K-Nearest neighbor are used as base leaners or level -0 learners and Artificial neural network is used as Meta model.***

Keywords: ***Data Mining, Data Collection, Secondary Data Sources, Weather Data, Rainfall Prediction, Machine Learning.***

I. INTRODUCTION

Data mining is a process of knowledge discovery from large amount of data. [1] It is not a very old concept and evolved significantly from last two decades. With evaluation of hardware and introduction of integrated circuits (IC's) in the computer, processing power of the machine has increased exponentially. [2] The introduction of LSI (Large scale integration) and VLSI (Very large-scale integration) increased the ability of machine up to a level which will allow the user to process large amount of data. [3]. The process of knowledge discovery starts with collecting the related data. It can be done in two ways. Data can be either collected directly for the process called primary data or already collected data can be obtained from a data source called as secondary data. [4]

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The collected data is preprocessed before using it for the analysis. In preprocessing of data, missing values and outlier analysis has been done. The preprocessed data has been sent for analysis using data mining techniques. [5] After the analysis the result will be in form of meaning patterns and relationship between attributes. This complete process has been shown in figure 1. [6]

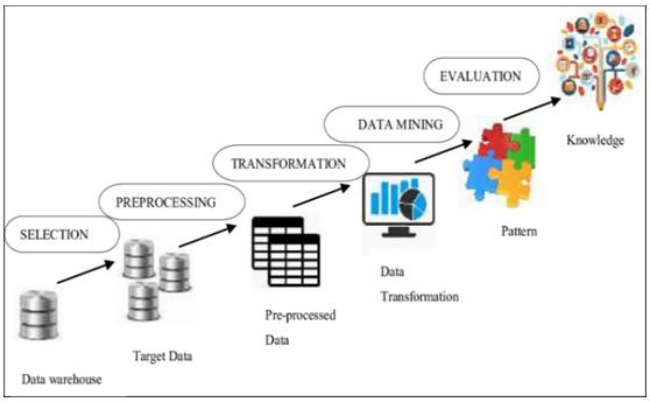


Figure 1: Process of Knowledge discovery (KDD)

II. PROPOSED RAINFALL PREDICTION MODELS

In this work, three rainfall prediction model based on ensemble-based data mining techniques are proposed. The bagging-based rainfall prediction model (RPM-BAG) has been shown in figure 2. [7] In this model, bagging ensemble data mining technique is used. Artificial neural network has been used as base learner. [8] A total of 20 ANNs are used to design the model and all are trained in parallel. [9]

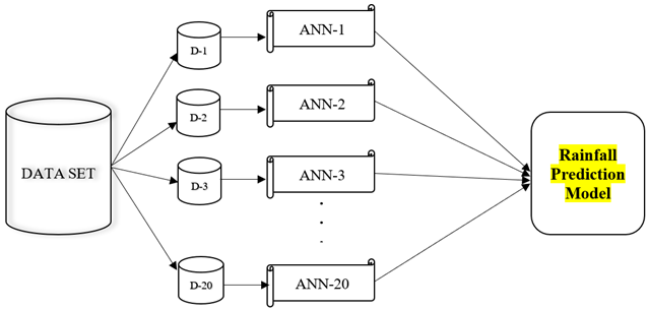


Figure 2: Rainfall prediction model-based Bagging (RPM)

The second proposed rainfall prediction model is based on boosting ensemble method which is shown in figure 3. [10] In boosting ensemble method, a base learner trained multiple times in which output of one become input for next and so on.

[11] In this way boosting method increase the overall accuracy and precision of the base learner. Here, the artificial neural network is taken as the base leaner.

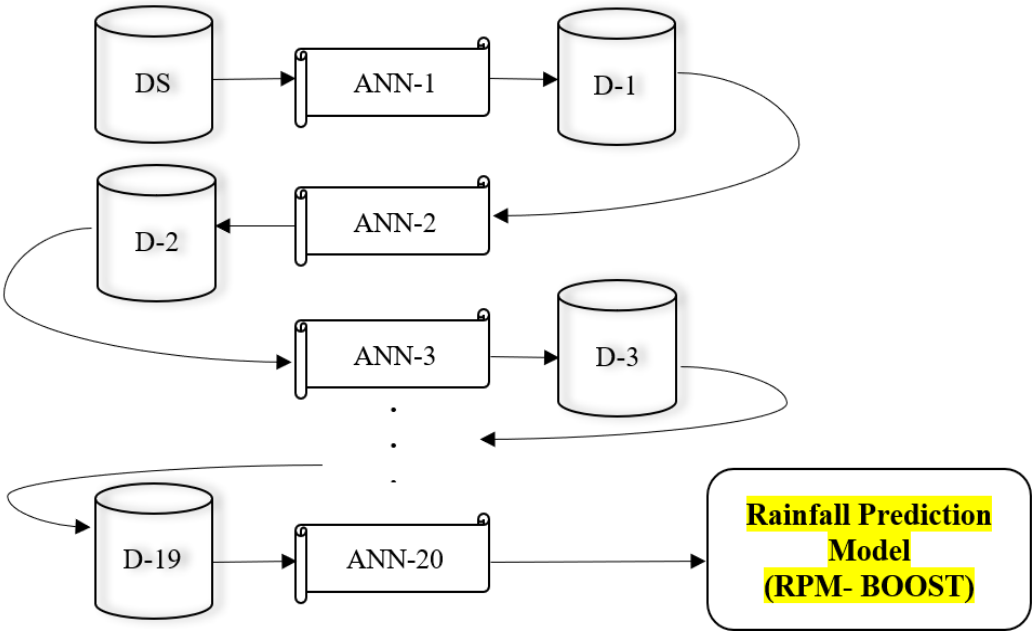


Figure 3: Rainfall prediction model-based Boosting (RPM)

The third proposed model is based on stacking ensemble data mining technique which is shown in figure 4. In stacking ensemble data mining technique, the weak learners which are also called Level-0 learners are trained using the original data set. [12] The prediction output of these level -0 learners is used as training set of level -1 learner also called as meta model. In this staking-based rainfall prediction model, random forest, logistic regression and K-nearest neighbor are used as level-0 learners and artificial neural network is used as level -1 learner or meta model. [13] These models are compared with each other and then compared with already existing models for rainfall prediction using data mining techniques. [14]

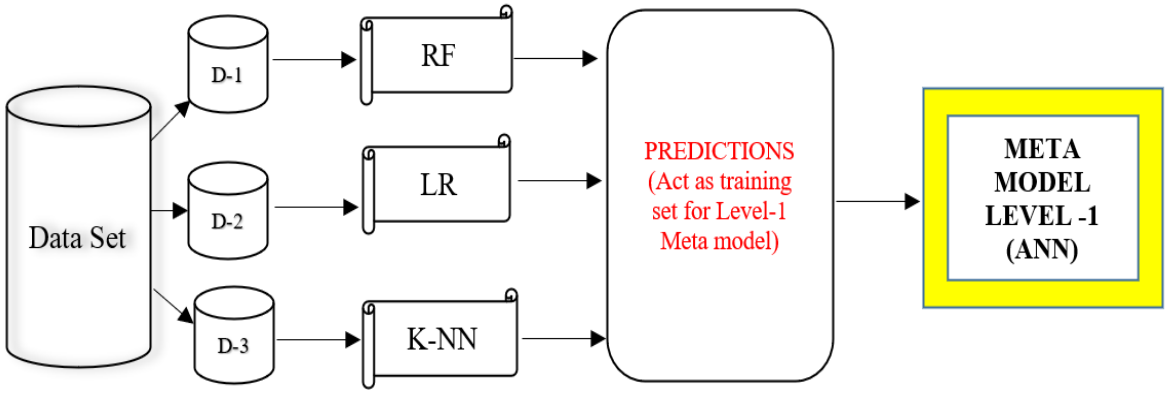


Figure 4: Rainfall prediction model-based on Stacking (RPM)

III. COMPARISON WITH THE EXISTING MODELS

The proposed models and existing models are compared based on accuracy, precision, recall and RMSE in this section. [15]

Table 1: Comparison of proposed rainfall prediction model

S. No.	PARAMETERS	RPM-BAG	RPM-BOOST	RPM-STACK
1	ACCURACY	89.14 %	88.53 %	88.82 %
2	PRECISION	79.87 %	77.9 %	78.62 %
3	RECALL	71.08 %	71.3 %	70.88 %
4	RMSE	0.284	0.315	0.295

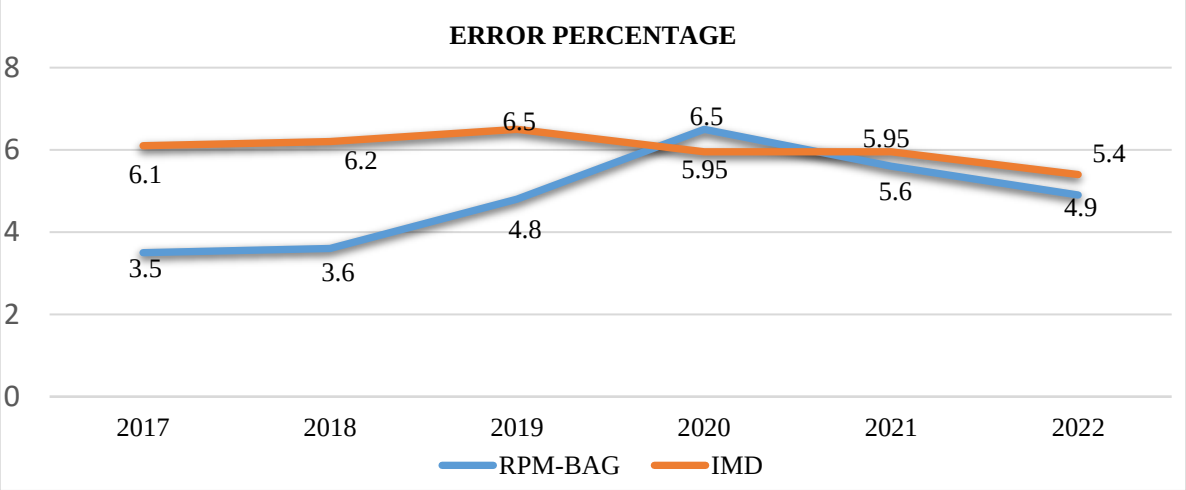
Table 2: Comparison of existing rainfall prediction model

S. No.	PARAMETERS	KC (ML-ANN) [8]	MM (SVR) [13]	DP (MLR, ANN) [14]
1	Accuracy	81.2 %	84.3 %	87.24 %
2	Precision	76.2 %	74.3 %	77.1 %
3	Recall	69.2 %	68.3 %	70.2 %
6	RMSE	0.446	0.375	0.327

Table 3: Comparison of proposed rainfall prediction model and existing models

S. No.	PARAMETERS	PROPOSED MODELS			EXISTING MODELS		
		RPM-BAG	RPM-BOOST	RPM-STACK	KC (ML-ANN) [8]	MM (SVR) [13]	DP (MLR, ANN) [14]
1	Accuracy	89.14 %	88.53 %	88.82 %	81.2 %	84.3 %	87.24 %
2	Precision	79.87 %	77.9 %	78.62 %	76.2 %	74.3 %	77.1 %
3	Recall	71.08 %	71.3 %	70.88 %	69.2 %	68.3 %	70.2 %
4	RMSE	0.284	0.315	0.295	0.446	0.375	0.327

IV. COMPARISON WITH OTHER PREDICTION METHODS



V. CONCLUSION AND FUTURE SCOPE

In this work three rainfall prediction model based on ensemble data mining technique are proposed and compared with the already existing prediction methods. [16] The comparison has been done on the basis of accuracy, precision, recall and RMSE (Root mean square error). [17] Out of three proposed rainfall prediction models bagging based prediction models performs the best with accuracy as 89.14 %, precision as 79.87 %, recall as 71.08 % and root mean square error as 0.284. [18] Also, the performance of the proposed model is better as compared to the existing model as shown in the comparative analysis section. [19]

DECLARATION

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Authors Contributions	All authors have equal participation in this article.

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