

Rainfall prediction using Machine Learning

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Abstract—Rainfall is a very important factor in daily life, as it is necessary for the survival of animals and plants, it is also a necessary factor in agriculture for growing crops etc., Rainfall will be difficult to predict using old methods, there are various ways for predicting the rainfall up until now, but as the technology increases the accuracy of the prediction increases. If the prediction of the rainfall is accurate enough it will help many people in planning their days, farmers for their crops and fishermen for the daily job basis. Although researchers have nearly found the efficient method but it still lacks in terms of accuracy, To solve this problem we developed a model using Machine learning Algorithms, which can predict the Rainfall based on the atmospheric factors to conclude whether it will rain or not. Many factors are responsible for rainfall, using this factors we can compare with the current factors. This will be extremely helpful for the meteorological department in forecasting the rainfall.

Index Terms—Machine learning, rainfall, prediction

I. INTRODUCTION

To implement this model we used python programming language and some necessary libraries such as Numpy, Pandas, matplotlib, sklearn. We fetched the existing dataset of rainfall parameters such as temperature, humidity, windspeed. First we will pre-process the dataset, pre-processing includes outliers removal, null value replacing. The important factors of rainfalls are :- Max-Temp : lower humidity : High Sunshine : Less wind speed : High further we train the models using algorithms such as ,KNN classifiers,logistic regression, XGBClassifiers, SVC. We can add even more classification algorithms to increase the chances of evaluating the most efficient and accurate model. To evaluate the performance of the classifiers, the evaluation metrics are included such as precision, f1-score and recall with the results.

II. LITERATURE REVIEW

[1] This paper analyzes various parameters in the atmosphere. Different weather features such as Temperature, Humidity, Dew Point are identified, and a detailed study is presented. While all features play a important role in rainfall classification, only a few of them. Based on these, an efficient set of features are used in a data-driven machine learning algorithm for rainfall prediction [2] In this paper, ML and DL rainfall forecasting approaches including a hybrid optimized-by-PSO support vector regression (PSO-SVR), long-short term memory (LSTM), and convolutional neural network (CNN).This paper pointed that PSO-SVR and

LSTM approaches performed almost the same and better than CNN. [3] In this paper, machine learning methods are evaluated, driven by atmospheric patterns, for long-term daily rainfall prediction in a semi-arid climate..The performance of the models is evaluated using several metrics and statistics related with rainfall intensity and occurrence at daily, monthly and annual aggregation scales. These analysis of variance are used to evaluate the differences among models. [4] This paper presents a comparative analysis using simplified rainfall estimation models based on conventional Machine Learning algorithms that are efficient for these downstream applications. Models based on XGBoost, and an ensemble of XGB regression, Linear Support Vector Regression, were compared in the task of forecasting hourly rainfall volumes using time-series data.[5] This paper talks about the various methods and models utilized in rainfall prediction: These models focuses on machine learning algorithms remote sensing techniques and hybrid approaches and highlights the significance of accurate rainfall forecasting for various sectors. Machine learning algorithms used are decision trees, random forests, support vector machines and recurrent neural networks. The paper uses remote sensing techniques, utilizing satellites and radar systems provide valuable data for rainfall estimation over large areas and in real time, enhancing the precision and timeliness of forecasts. Hybrid models combining machine learning and remote sensing offer promising avenues for improving prediction accuracy. The paper talks about using advanced technologies for more accurate and reliable rainfall forecasting. [6] This paper basically compared 24 machine learning models for day ahead photovoltaic (PV) power forecasting using numerical weather predictions (NWP). They found that the kernel ridge (KR) model performed best in terms of accuracy, although it required extensive training time and memory usage. The multilayer perceptron (MLP) model showed identical accuracy but with lower training time The paper showed that including additional predictors beyond basic NWP outputs led to a reduction in root mean square error (RMSE), Hyperparameter tuning was also found to be usefull for optimizing model performance with tuned models achieving lower RMSE compared to default settings. Their findings provide valuable insights into selecting the most suitable ML models and input features for operational PV forecasting. [7] This paper is on rainfall prediction across various ecological zones in Ghana: In this paper they have used

five classification algorithms Decision Tree, Random Forest, Multilayer Perceptron, Extreme Gradient Boosting, and K-Nearest Neighbour. They have used evaluation metrics such as precision, f1-score, recall, overall accuracy and execution times to assess the performance of the classifiers. The results reveal distinct classification characteristics for rain and no rain classes in different zones. Decision Tree had the fastest execution time across all zones while Random Forest, Extreme Gradient Boosting and Multilayer Perceptron demonstrated consistent performance suggesting their suitability for rainfall prediction. In future research they have told to explore additional classification algorithms and hybrid models. [8] The paper demonstrates two methods for forecasting rainfall: One based on Autocorrelation Function (ACF) and the other on projected error. they have also used various regression models like Bayesian Linear Regression (BLR), Boosted Decision Tree Regression (BDTR), Decision Forest Regression (DFR), and Neural Network Regression (NNR). They have observed that BDTR performs best in predicting rainfall using ACF with noticeable improvements achieved through cross validation and hyper parameter tuning. BDTR and DFR with LogNormal normalization demonstrated superior performance particularly in weekly error prediction. The study concludes that method 1 which is based on ACF provides the best rainfall prediction while acknowledging the potential for further enhancement. [9] The paper is a study on rainfall prediction in India: Various machine learning algorithms such as ARIMA, Artificial Neural Networks (ANN), Support Vector Machines (SVM), and Self Organizing Map (SOM) are used in this paper. Deep learning techniques like Multilayer Perceptron (MLP) and Auto Encoders are introduced for rainfall prediction which outperforms the traditional methods in terms of Mean Squared Error (MSE) and Root Mean Squared Error (RMSE). The study highlights the significance of accurate rainfall prediction for agricultural planning and disaster prevention and shows the potential of Artificial Neural Networks in handling nonlinear relationships in rainfall datasets. [10] The paper introduces a study focused on improving weather prediction methods to address the challenges posed by climate change: The paper particularly focuses on sectors like agriculture heavily reliant on weather conditions. The paper uses data analytics and machine learning like the random forest classification algorithm This method demonstrates results with an accuracy of 87.90 percent in predicting rain occurrences.

III. DESIGN METHODOLOGY

The first part of our methodology involves the pre-processing the data which includes handling missing data, removing outliers, normalization. We after categorize the data into 2, training data and testing data. After that we will present the results based on the performance of the models. To evaluate accurate results, EDA Exploratory Data Analysis is used.

A. understanding the data

In this section, we discuss about the dataset. We have used a dataset that contains the rainfall factors details categorised

according to the location in Australia. (weatherAUS.csv). This dataset contains features such as Date, Location, MinTemp, MaxTemp, Humidity, WindGustSpeed, evaporation, sunshine, windDir, pressure some are categorised according to the time, for example cloud at 9 am, cloud at 3 pm. Finally there is target label which declares whether it rained on that particular day or the day after or not also the risk factor is mapped.

B. Pre-processing the Data

Pre-processing or cleaning the data is necessary, this will increase the accuracy of the calculation and also provide clarity to each segment of the data. We start of with the process of removing unwanted features such as the date, location, Rainfall, cloud9am, cloud3pm, risk-MM. Winddir. some of these features contains many null values, too much categorical data, irrelevant data. Next, we go with the process of replacing the null values with either mean/median for numerical data, or most-frequent for categorical data. To achive this, scilearn developed scikit library is used. So now we have a clean accurate data with relevant features. All these changes will be saved into the dataframe which will then be used for the next section that is Plotting the data.

REFERENCES

- [1] Shilpa Manandhar et al. "A Data-Driven Approach for Accurate Rainfall Prediction", IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 57, NO. 11, NOVEMBER 2019, 0196-2892 © 2019 IEEE
- [2] Fatemeh Rezaei Aderyani et al., "Short-term rainfall forecasting using machine learning-based approaches of PSO-SVR, LSTM and CNN", Journal of Hydrology 614 (2022), 0022-1694/© 2022
- [3] Javier Diez-Sierra et al., "Long-term rainfall prediction using atmospheric synoptic patterns in semiarid climates with statistical and machine learning methods", Journal of Hydrology 586 (2020) 0022-1694/ © 2020
- [4] Ari Yair Barrera-Animas et al., "Rainfall prediction: A comparative analysis of modern machine learning algorithms for time-series forecasting", 2666-8270/© 2022
- [5] S. D. Latif, N. A. B. Hazrin, C. H. Koo, J. L. Ng, B. Chaplot, Y. F. Huang, A. El-Shafie, and A. N. Ahmed, "Assessing rainfall prediction models: Exploring the advantages of machine learning and remote sensing approaches," Alexandria Engineering Journal, vol. 63, no. 3, pp. 1325-1335, Sep. 2023. [Online]. Available: <https://doi.org/10.1016/j.aej.2023.09.009>.
- [6] D. Markovics and M. J. Mayer, "Comparison of machine learning methods for photovoltaic power forecasting based on numerical weather prediction," Renewable Energy, vol. 188, pp. 812-824, Mar. 2022. [Online]. Available: <https://doi.org/10.1016/j.renene.2022.03.093>.
- [7] N. K. A. Appiah-Badu et al., "Rainfall Prediction Using Machine Learning Algorithms for the Various Ecological Zones of Ghana," IEEE Access, vol. 9, pp. 19425-19439, 2021. DOI: 10.1109/ACCESS.2021.3139312.
- [8] W. M. Ridwan, M. Sapitang, A. Aziz, K. F. Kushiar, A. N. Ahmed, and A. El-Shafie, "Rainfall forecasting model using machine learning methods: Case study Terengganu, Malaysia," Ain Shams Engineering Journal, vol. 12, pp. 1651-1663, Nov. 2020.
- [9] C. Zeelan Basha, N. Bhavana, P. Bhavya, and S. V, "Rainfall Prediction Using Machine Learning and Deep Learning Techniques," in Proceedings of the International Conference on Electronics and Sustainable Communication Systems (ICESC 2020), ISBN: 978-1-7281-4108-4, IEEE Xplore Part Number: CFP20V66-ART.
- [10] N. Singh, S. Chaturvedi, and S. Akhter, "Weather Forecasting Using Machine Learning Algorithm," Noida, India, 2019, pp. 1-5, ISBN: 978-1-5386-9436-7.

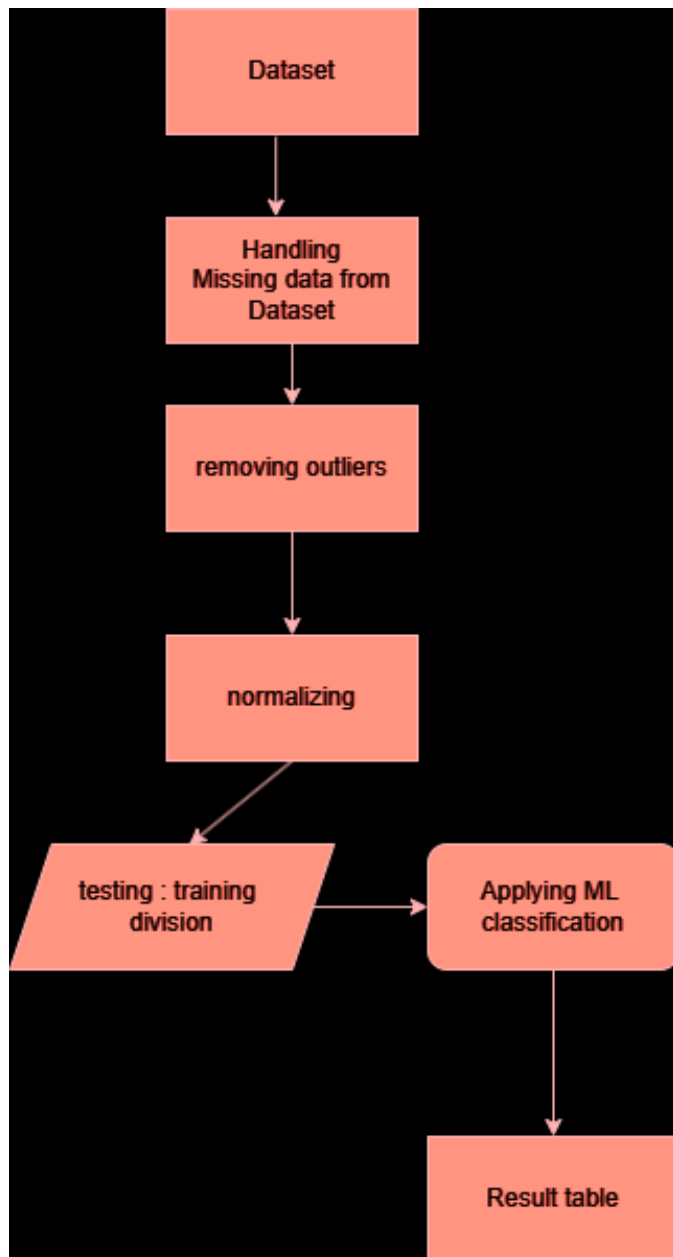


Fig. 1. Design Flowchart