International Journal of Combined Research & Development (IJCRD)
eISSN:2321-225X; pISSN:2321-2241 Volume: 14; Issue: 8; August- 2025

RAINFALL PREDICTION USING MACHINE LEARNING AND NEURAL NETWORKS

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ABSTRACT

The timing and the amount of rainfall stands among the top critical areas of weather forecast which is crucial in agriculture, water resource planning, and prevention of disasters as well as in day to day decision making. The project includes the rain forecast mechanism by adopting machine learning, which can tell the likelihood of rain on any given day based on past weather history. Radom forest is an algorithm that applicable in handling complex dataset that include both mathematical and category-based attributes, therefore, making the algorithm applicable in the system. This is where raw dirty data was cleaned missing value data, categorical type data variables were discretized and a data set was trained. As the next step. The Random Forest was a satisfactory model that could be saved and used at any other time ina modelling serialisation form. Owing to the ease-of, the web-based application relies on Flask libraries, HTML, CSS and graphics to render the predictions to the end user in an explicit manner. The application has the prospect of entering the meteorological data and see the estimation instantly in the form that would be easily accessible, since it would be illustrated by the visual data that it would be raining or sunny.

KEYWORDS: Machine Learning, Neural networks, Predictive modelling, Regression modelling, AI in environmental science, Data mining, prediction system, prediction system on the web

INTRODUCTION

Forecasting weather has been accounted ever among the inmost significant scientific challenges, as it directly impacts human life, agriculture, transportation, disaster management, and overall economic planning. Among the different weather phenomena, rainfall forecasting plays a crucial role because of its direct influence on food production, water resource management, and

preparedness against floods and droughts. Traditionally, rainfall predictions were made using statistical models and meteorological simulations; yet these methods frequently face challenges with the highly complex and non-linear nature of climate data. Advances in the machine learning, and in the devices with limited resources available. Compared the more conservative algorithms such as RSA and AES, the Elliptic Curve Cryptography seems to be a more promising way to go due to its shorter key-length and lesser computing requirements. The current study has been titled as Machine learning models for Rainfall Predictions and neural networks Classifier and under this work the random forest classifies was used in the model, with one parameter; it was applied where the next day was predicted according to the previous weather data and output served as the input.

LITERATURE SURVEY

One activity that has gained most research is the prediction of rain because it is one of the activities under the agricultural sector, and even in the sense of managing water- a major activity and also in planning any man-made emergency. Inherent problems include ones of statistical treatment and numerical weather predictions which do not blend with the established framework given climate systems are not linear in structure. The proposed solution to fixing this problem is machine learning that is already a successful and promising rain forecasting system considering excessively large databases in a manner similar to the Australia Bureau of Meteorology WeatherAUS. The random forest algorithm has reportedly been accurate and quite strong on the nature and the count of variables; missing values, and excessive fit. Comparison Weather has been accounted ever among the inmost and logistic regression highlighted that; Random forest only works performs strongly in identifying rainfall during the day. This gives it people as a good application in the modelling of the forecast in the current project. It also demonstrates more recent applications of the deep learning algorithm like the LSTMs and the GRUs and these could do has great strength in detecting the temporal correlations in the rainfalls or the rainfall intensities over a series of rainfalls/intensities. The algorithms lack flexibility in sharing knowledge and computer skills and has not been the best fit to be utilized in day-to-day predicting of the binary document.

EXISTING WORK

This is the two last years when a machine learning and the solution of the task of predicting rainfall was achieved to make the practice closer. Among the first models to be applied will include the linear regression, as well as the decision trees. These models were modeled according to the past weather

records comprising temperature, humidity and direct wind speeds in predicting rain. They have also wandered in bringing in some positives but have lacked to find a way of resolving complex association in a non-linear manner. To overcome the mentioned challenges, other advanced methods of analysis have been added including random forest algorithms and support vectors machines (SVM) and Gradient Boosting. The approach led to more accurate forecast as it would be in a better position of coming up with the elusive trends within the large content of data. In more modern times the ANN, CNN and the Long Short-Time Memory, (LSTM) neural networks, and other more deep systems also became interesting. LSTM, a special model of RNN has achieved great success due to its inner algorithm and computation of measuring the long-range dependency in time series modelling. This contributed to the integration of the neural networks and deep learning paradigms, i.e., Artificial Neural Networks (ANN), convolutional Neural Network(CNNS), and, specifically, Long-Term Short-Memory (LSTM), networks. The two LSTM models have been susceptible to usefulness because it is able to manage time series data. In other instances combined models have been generated and it has introduced clearer and more secure combinations of algorithm.

PROPOSED SYSTEM

The actual concept of the proposed system would be to provide meaningful and non-hazardous rain prediction through a web-based interface platform with the use of machine learning. The system first acquires the past weather data, Weather AUS data, the most major features or what is of concern in the transformations in factors influencing weather, such as Temperature and Humidity. the directional way that the wind blows, pressure level and weather- preceding records of rainfall among others. This raw data is provided to a data preprocessing pipeline to replace missing data in the data, encode Converting categories into Numbers and normalisations of numerical values to bring the data to a form they can used as train the models. This step guarantees lucidity of the data and eliminates the possibility of biases that might impound predictive accuracy .The model the core of the system is Random Forest classifier widely used for selected because of its stability in predicting both numerical and categorical features, its capacity to mitigate overfitting through combination learning, and because of its successes from studies conducted in the past on prior rainfall prediction. The model is trained during its training stage using a large volume of data with the kept-aside testing set to provide the estimation of the generalization

performance. Evaluation of performance is done not only using accuracy, together with precision, recall and F1-score, to ensure that system can effectively recognize rainy and non-rainy days regardless of the class imbalances. After training, the model is serialized using Pickle library to allow it to be quickly loaded in real-time prediction .To deploy it, the trained Random Forest model will be integrated into a Flask-based web application

METHODOLOGY

The methodology of this rainfall prediction project follows a planned process that begins with the preparation of the dataset and ends with the The dataset utilized is the WeatherAUS dataset, which contains daily weather observations from different regions of Australia. It possesses not only the numeric variables, measurements of temperature, humidity and pressure, rainfall also the categorical variables, directions of the wind and coverage of the clouds. Before the development, The data preprocessing step was substantial, given the characteristics of data used (inconsistencies). The missing information was even addressed in the best manner by using the applicable statistical mechanism or omitted where the missing was too high and the categorical variables to correspond to the numerical form in order to be treated by the machine learning model. All of the numeric attributes were normalised also ensuring they do not bias the training of the model excessively. Order to see the variables of unequal classes, the data was further analysed since non-rainy days are more than rainy days. To fit this ability of the model to predict the minority cases alongside the aptitude that they were adjusted was levelled. The framework accordingly introduces the balance between highly safe encryption and necessity to work in the reality time as the framework aligns with the cloud based scale service and employs the lightweight encryption key built upon Elliptic-Curve cryptography. When implementing medical smart system in the field of contemporary health care, the creation of credible and the safest medical smart system is possible. The method applied in gathering the data in so far as it predict Rainfall, it is the historical data of the climate in the fields of temperature and rainfalls in the past. The data is then corrected and the errors and anomalies in data corrected, outliners removed and the dimensions standardized in order to make the model to perform optimally.

EXPERIMENTAL RESULTS

The outcomes of the experiments of the Rainfall Prediction project clearly demonstrate the effectiveness of the developed model and graphical interface in predicting whether the following day will experience rainfall or remain sunny. As shown during the test cases, the user enters a number of weather conditions like temperature, humidity, wind speed and cloud cover, and rainfall history into the system. Once the data is submitted, the prediction model processes these inputs and provides an output takin the form of the easily interpretable message accompanied by a relevant graphical illustration. For instance, when weather conditions suggested high cloud cover, humidity, and supporting factors for rainfall, the system predicted that "Tomorrow is set to be a rainy day!" and displayed a rain-themed image. On the other hand, when the provided input parameters reflected clearer skies and lower precipitation probabilities, the system confidently predicted "Tomorrow will be a sunny day!" with a bright sun animation. These findings not only validate the accuracy and reliability of the model but also show the data analysis was performed pointing out its user-friendliness in presenting predictions in a simple and engaging manner.

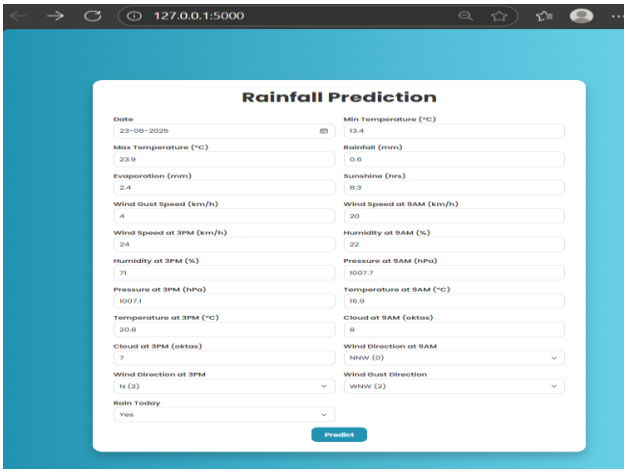

Fig.1. Rainfall Prediction Web form with weather parameters

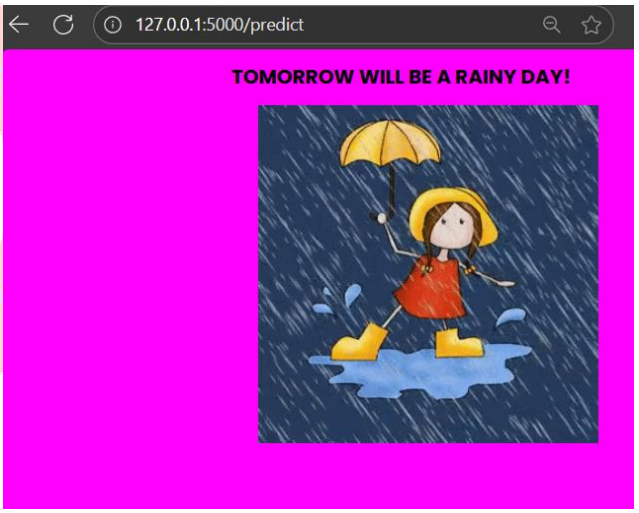

Fig.2. Prediction result- Rain Expected Tomorrow

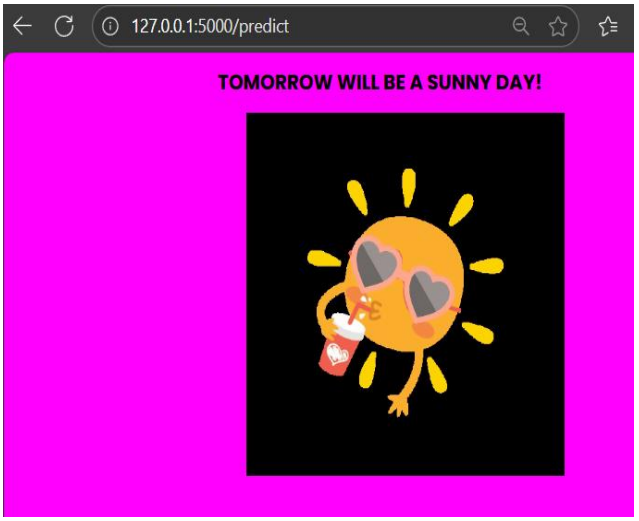

Fig. 3. Rainfall Prediction result- Sunny Day Expected

CONCLUSION

The Rainfall Prediction project concludes with the successful development of an intelligent system capable of forecasting rainfall using historical weather parameters and machine learning techniques. The project demonstrates how meteorological data such as temperature, humidity, wind speed, cloud cover, and rainfall history can be effectively processed to generate accurate predictions about the likelihood of rain on the following day. The results highlight the system's ability not only to provide accurate outcomes but also to present them in an interactive and user-friendly graphical interface, making it accessible even to non-technical users. By visualizing predictions through simple text messages and illustrative graphics, the project bridges the gap between complex machine learning models and practical day-to-day applications. This approach not only supports individuals in planning daily activities but can also aid agricultural planning, disaster preparedness, and resource management. Overall, the project underscores the importance of combining data science with intuitive design, offering a reliable, scalable, and practical solution for real-world weather forecasting challenges.

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