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Cloudburst Prediction System Using Machine Learning

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Abstract: Cloudbursts are intense spells of rainfall and sudden occurrences resulting in much damage to the environment and loss of life. Hence predicting these events with high accuracy plays a critical role during such events. This paper presents systematic study on development and implementation of cloudburst prediction system utilizing a binary classification model. The primary aim of our project is to enhance predictive accuracy and reliability.

In this manuscript, the authors propose a cloudburst prediction model that utilizes a multitude of ways for the forecast of cloudburst events based on a variety of features across India to predict real-time cloudburst disasters using certain cloudburst data.. The experiments conducted using logistic regression, SVM, and decision tree classifier models of machine learning. The SVM attained an initial stage of training AUC(Area Under Curve) ranging between 86% for training and 96% for testing. Discussion has been made concerning graphical result and comparison against other models. The system integrates with a weather API that will have real and updated meteoro-logical information like temperature, humidity, sea level pressure, dew point, cloud coverage, and wind speed. The results are then displayed on a web-based user interface that provides users the opportunity to interact with the prediction system.

Keywords: Cloudburst prediction, Machine learning Support vector machine (SVM), Decision tree classifier, Logistic regression, Real-time prediction

I. INTRODUCTION

Cloudbursts are short, intense bursts of rain, usually in a period of several hours, generating huge amounts of rain in few hours. This is known to lead to landslides; thus, causing widespread damage to the environment. The term cloudburst is heavy and sudden rainfall in a particular area with high intensity and a large discharging quantity of cloud, and such phenomenon generally occurs in hilly areas. The North Indian states are most affected by cloudburst in India.

There are several factors which affect the occurrence of a cloudburst event. The main factors leading to cloudburst may be divided into three classes, such as geographical characteristics, types of clouds and hydrological conditions. The factors that can be used in the project include atmospheric parameters such as temperature, humidity, dew point, sea level pressure, cloud coverage, wind speed, etc. Each factor plays a unique role in the prediction of cloudburst.

Prediction of cloudburst has always remained a challenge for every researcher since the occurrence of an event is by nature. According to IMD, cloudburst is defined by an intense burst of precipitation rates of 100-110 mm/h over a very short time and a very small geographical area, such as a town,hill station, or city, covering roughly 20-30 km3.

For example, cloudbursts occur within the area of 20-30 km2 with a rain intensity of 100-110 mm/h lasting for a short period, often in the range of about an hour.

The authors have presented a real-time cloudburst prediction system that makes use of a binary classification model based on machine learning. The aim of this project is to develop a system that combines advanced techniques and meteorological data in order to improve prediction capabilities concerning cloudburst events. The approach is to develop a machine learning model, using a mixture of Logistic Regression, SVM (Support Vector Machine), and Decision Tree Classifiers.

It must be noted that if there are very few cases of cloudburst under which cloudburst events happened, the cloudburst conditions do not continue; thus, the performance of the developed model is tested where there were no cloudburst events using other ML algorithms and results are given.

II. LITERATURE REVIEW

[1] Bartwal K. et.al "Rainfall Prediction Using Machine Learning," 2nd International Conference Disruptive Technologies (ICDT), Greater Noida, India, 2024.

This research at the outset, this paper opts for a full-fledged procedure for data preprocessing using Theil-Sen regression for imputation, re-sampling to balance datasets, and encoding of categorical variables hereafter. Seaborn visualization techniques and Matplotlib were used to verify for imbalances in data and outliers.

Feature engineering was all about getting the features into a parameter of their best performances and excluding features that are less important. These include Random Forest, SVM, XGBoost, Logistic Regression, KNN, and LightGBM, which were subjected to validation against metrics like sensitivity, specificity, and accuracy. Based on the comparative results of the experiments, the authors identify both Random Forest and XGBoost models as being adequately valid under validation and test conditions, but LightGBM was finally pointed out for the final choice for predictions with maximum accuracy. Here much importance is given to the power of machine learning in contexts requiring decisions and actions where most economic sectors rely heavily on the accuracy of weather forecasts.

[2]A.Sebastian et.al, "Harnessing AI for Cloudburst Forecasting and Warning," International Conference on Circuit Power and Computing Technologies (ICCPCT), The timing and location of cloudbursts in and around hilly regions remain unpredictable. Historically, a majority of the events of cloudbursts are destructive and hazardous, making them hard to observe. A lot of times, these have been recorded after they've been in to destroy, most of them from flash floods that occur due to abrupt rain. The basic idea related to cloudbursts regards a sudden heavy rain over a small land area over a very short time span. Other than this knowledge and description by IMD of N100 mm/h of precipitation covering an area of about 20 to 30 sq.km, nothing much is known about such events. There have been few studies on cloudburst phenomena. These systems were found to be following a convectively induced cloudburst event and were connected as orographically locked systems. Thus cloud bursts result from these interlinked systems and never come into formation if any one of the mechanisms is missing. Hence this study represents a stream of thought that heralds an intelligent system to be able to forecast cloudbursts and warn the resident population of particular areas at risk. Data science and AI allow monitoring, analyzing several metrics related to pressure, humidity, rainfall intensity, temperature, etc. They inspired us to create a system that can predict cloudbursts in the village of Koottickal so that people can escape to a safe place.

[3] D. Karunanidy et.al, "Cloudburst Prediction in India Using Machine Learning."6th International Conference on Recent Trends in Advance Computing (ICRTAC), Chennai, India, 2023. Cloudbursts are extremely dangerous in India, especially during the South-West Monsoon season that starts in June. Different climatic zones have experiences with cloudbursts, which happen in various regions of India: the northern Himalayan region, Indo-Gangetic Plain, southern peninsula, and coastal areas, reporting only 31 cases, primarily in Himachal Pradesh, Uttarakhand, and Jammu and Kashmir.

The work entails the compilation of statistical data pertaining to cloudbursts to remedy the nonavailability of reliable data in Indian consideration. The dataset contains meteorological predictors for cloudburst predictions, including such variables as Temperature, Wind Gust, Wind Gust Speed, Humidity, Monsoon patterns, Air Pressure, and Cloud Density. We aim to build preparedness and mitigation measures to save lives and property in cloudburst-prone areas. On board fully optimized machine learning algorithms, our model takes such parameters along with prevailing weather conditions to understand the occurrence of cloudburst events. Prediction performance within the learning algorithms of Random Forest, Cat Boost, XG Boost, and Decision Tree is evaluated. The Cat Boost outperforms with an accuracy of 86.18%. Besides, we provide graphical insights into the relationships between humidity and cloudburst occurrences to underline the importance of weather variables in prediction models.

It would give the cloudburst forecasting more vitality, in spite of a shortfall of Indian data input and holding prospects to try various machine learning techniques for better accuracy.

[4] M. M. Hassan et.al, "Machine Learning-Based Rainfall Prediction: Unveiling Insights and Forecasting for Improved Preparedness". Rainfall forecasting finds a far more compelling use when it is viewed as a prelude to a warning of possible dangers associated with rain and gives people the chance to take the requisite measures to avoid them. This study aims to apply machine learning algorithms to accurately forecast rain, looking at the major effects of extreme rain or drought on rural and urban life. The area of rainfall forecasting is extremely complicated because many phenomena exert their influence-though themselves influenced by various atmospheric, oceanic, and geographic factors. Several data preprocessing techniques, outlier testing, correlation analysis, and feature selection are performed on several machine-learning algorithms, including Naive Bayes (NB), Decision Tree, Support Vector Machine (SVM), Random Forest, and Logistic Regression. The study is concentrated on providing the most accurate model for predicting rain built around machine learning and feature selection techniques. The ANN has the best accuracy results of 90% before the selection of best features and 91% after such selection. The authors also applied K-Means clustering and PCA to extract regional patterns of rainfall in Australia. In this journal, we also provide a web-based application system using Flask to make our proposed machine learning simpler and user-friendly to common people.

In general, this work shows the capability of various different machine-learning approaches for predicting rainfall from Australian weather data. vol. 11 132196-132222, 2023.

[5] K. G, Y. Sushmitha et al., "Rainfall Prediction Using Deep Learning and Machine Learning Techniques." International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI), Chennai, India, 2023, pp. 1-7. Rainfall predictions are crucial in today's world of weather forecasting affecting agriculture, hydrology, water management, and disaster preparedness as well as disaster response. Rainfall prediction has always been based on historical data and meteorological observations.Trending of rainfall over the coming years has been found to have more recent and accurate applications today since current technological advances in regards to computer models, remote sensing technologies, and the establishment of machine learning and deep learning algorithms add weight behind making better and accurate predictions on rainfall patterns. This paper reviews techniques for predicting rainfall employing satellite imaging data, atmospheric conditions, ocean temperatures, and other climate variables. Besides presenting machine learning, this paper provides insight into how deep neural networks are able to develop more sophisticated models that are even capable of assessing ocean data and predicting rainfall patterns correctly.

[6] Shaji et al., "Weather Prediction Using Machine Learning Algorithms," 2022 International Conference on Intelligent Controller and Computing for Smart Power, May 12-14, 2022, Hyderabad, IndiaThus, importance of weather forecasts is being stressed more and more to save time, money, property or lives. The major chunk being the air with hand-operated observations implies that an Indian meteorological station hardly covers more areas of unpopulated territories due to lesser flexibility to move there. Obviously, this may lead to more ambiguity and inaccuracy in making forecasts for remote areas causing a hassle to people like farmers who rely a great deal on weather reports for their daily undertakings. The authors have employed various machine learning techniques for predicting weather based on certain variables: temperature, apparent temperature, humidity, wind speed, wind bearing, visibility, cloud cover using Random Forest, Decision Tree, MLP classifier, Linear regression and Gaussian naive Bayes. Based on the results found, a comparative study is going to be interesting enough, to compare accuracies.

[7] Bhuvaneswar Reddy et.al, "Cloud Burst Forecast Using Expert Systems". An MLR model is proposed to predict rainfall from an Indian dataset using various meteorological parameters for a more accurate prediction outcome. Our experimentation utilized metrics including MSE, accuracy, and correlation, all of which performed better than their other counterparts. Through these literature reviews, rainfall prediction methods are reviewed, emphasizing the importance of rainfall forecast accuracy to agricultural scheduling and other enterprises. International Research Journal of Engineering and Technology (IRJET), Vol (09), Issue (08), August (2022), Pages 1552-1555.

[8] Indra Kishor et.al, "Application of Cloudburst Prediction System: A Review," Industrial Engineering Journal, 51(7). This study focuses on cloudburst prediction systems, with highly relevant literature on the integration of Convolutional Neural Networks(CNNs),weather forecasting, and data mining for real-time prediction. The authors provide a developmental trajectory of prediction methods and propose machine learning-based approaches toward achieving higher accuracy levels. The Cloudburst Prediction System, notwithstanding multiple challenges such as false alerts, could prove beneficial to disaster management. The works associated with smart agriculture and renewable energy are connected with this paper.

[9] Oswal, N. "Machine Learning Techniques for Rain Predictions." This study is engaged with predicting rain using machine learning (ML), entailing a great importance to several sectors. Commonly used machine learning (ML) techniques to analyze Australian weather data include Logistic Regression, Decision Tree, K Nearest Neighbour, and Ensembles. Classically, missing values, categorical features, and scaling were managed appropriately in data preparation. Univariate Selection and Correlation Matrix were the methods of feature selection used. The class imbalance was managed via undersampling and oversampling techniques. Comparative experiments with the original dataset, undersampled dataset, and oversampled dataset were done. The evaluation was done by predicting Correctness, Precision, Recall, F1 Score, and AUC. Speed of performance differs for one classifier to another varying with the dataset. The undersampled Logistic Regression did better than others. Decision Tree performed well in oversampling. Overall, Gradient Boosting was efficient. Some statistics, such as a paired t-test, were employed.

[10] Adithya Sunil et.al, "An Intelligent Device To Predict Cloud Burst". In this way, this paper presents a sort of intelligent service, a computerized warning in the future to help people avoid the habitats in the event of heavy rainfall where they might be at risk. This proposed system uses the fundamentals of data science and artificial intelligence to monitor atmospheric pressure, humidity, rainfall intensity, temperature, and additional parameters regularly, thus enabling locals who live in flood-prone areas to receive timely warnings. The occurrence of the paper mentions cloudburst episodes taking place more frequently today, particularly among the hilly areas, like Kerala, requiring preventive measures to minimize loss of life and property from these disasters.

It is named "PREDISTER", where the system uses IoT technology for environmental parameter analysis and alerts creation in an event of anomaly detection that might subsequently lead to cloudburst; also can aid in quick response from the rescue forces in a disaster case, thus enabling timely evacuations and assistance.
The prototype and various components of the prototype and design considerations including those regarding portability and adaptability to different environmental circumstances are presented with elaborate explanations. The paper concludes, mentioning future aspects related to further enhancement of the project by implementing features like air quality monitoring and advanced visualization during rescue operations. International Journal for Research Trends and Innovation (IJRTI), Volume 7, Issue 6, ISSN: 2456-3315, 2020.

III. METHODOLOGY/EXPERIMENTAL

The project required data that had been collected from local weather data websites, which included parameters like temperature, humidity, sea-level pressure, wind speed, dew point, and cloud coverage. This historical weather data comprised the past occurrences of cloudburst losses.

A. *Feature Selection*

After selecting a dataset, we will then proceed to find out the features that comfort the prediction task in better ease. Therefore, we need to build our machine learning model using the best-fit features to get the predictions. In mutual scores, we get some features, such as humidity and temperature, to have high dependence with the occurrence of cloudbursts. In SVM, the RBF kernel was chosen since it could deal with the non-linear relationship between features and target variables.

B. *Machine learning model*

The proposed method employs 3 machine learning models, that is, Logistic Regression, SVM(Support Vector Machines), and Decision Tree Classifier.

1) *Support Vector Machine (SVM)*

SVM, or Support Vector Machines, is an extremely complex supervised machine learning model used in both regression and classification problems. When an RBF kernel is being applied, SVM takes care of the nonlinear relationship by mapping the input features from a lower-dimensional space to a higher-dimensional space.
SVM has this concept of hyperplane, which is a decision boundary that separates different classes. The idea is to locate that hyperplane that maximizes the boundary between classes. Support vectors are those data points that are lying closest to the hyperplane, and they are said to be really complicated in regard to defining the position and orientation.
For this project, SVM with RBF kernel was used to predict cloudburst events. The RBF kernel is also often referred to as the Gaussian kernel, where the data is projected into a higher dimensional space so that it can find a linear separation in this new space.
The RBF/Gaussian Kernel function is defined in the following way:

$$\mathbf{K(x_1, x_2) = e^{-y\|x_1 - x_2\|^2}}$$

Such that, y is the parameter which provides influence on a single training instance, and the examples for training, in our case x1,x2.
The dataset was first split 80 percent in favor of training and 20 percent in favor of testing. The SVM machine learning model with RBF kernel was used for the non-linear relationships it can catch up with. Then, hyper-parameter tuning was done for finding the right value of gamma and the number of iterations. The model after convergence started adjusting to a balanced state dynamically between complexity and performance as sufficient iterations passed.
Model evaluation in the process of training and testing based upon accuracy was carried out.
The graph shows how the accuracy of the SVM model varies against the number of iterations, and it defines the convergence behavior of the model shown in figure 1 below.

2) *Decision tree classifier*

Basically, nonparametric supervised learning algorithms use classification and regression to separate the data set into classes based on input features and achieve a decision-tree model.
Any area of the tree is recognized as a node, with each internal node in a tree representing either a decision and each branch representing the outcome of some decision. They are able to cope with both numerical as well as categorical data.

A data set is to first be split into a training set of 80% and a testing set of 20%. The decision-tree classifier will work with the training dataset. Upon completion of training, one must check how well the model did for different values of depth so that there is no overfitting or underfitting.
Model evaluation should be done on the basis of learning accuracy and test accuracy.

$$p = \frac{1}{1+e^{-(\beta_0+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_n x_n)}}$$

where:

- β_0 is the intercept term.
- $\beta_1, \beta_2, \ldots, \beta_n$ are the coefficients for the features $x_1, x_2, \ldots, x_n$.

This diagram shows the accuracy with the depth of the decision-tree classifier as in fig 2.

3) Logistic Regression:
It's a linear binary supervised classifier called logistic regression. Also known as the sigmoid function, logistic regression maps any real-valued number into the interval (0,1). Logistic regression predicts the probabilities of binary dependent variables.
The logistic function predicts the probability of the binary dependent variable (cloudburst). interval. Logistic regression predicts the probabilities of the binary dependent variable.
The logistic function predicts the probability of the binary dependent variable (cloudburst).
The data will be divided into about 80% for training and 20% for testing; the logistic regression model will be constructed on the training data.Hyperparameter tuning will be done for addressing the maximum number of iterations.The model will be evaluated by assessing the accuracy for training and test data sets.

C. Integration of experiment
The model of prediction of cloudburst is required to have a facility to save trained models and other necessary files in Pickle format so that the serialization and deserialization altogether tend to consume less time. This method allows one to save the model and reload it quite easily, followed by real-time predictions using the integration of a weather API that allows for current-time predictions based on real-time weather data.
As previously described train the machine Learning models are, and save this trained models into disk through the Pickle module. Now fetch the real-time weather data using a weather API and preprocess this data to match the format excepted by the machine learning models. Load the models from the Pickle files in API and make prediction using real-time weather data. To make the cloudburst prediction system user-friendly, integrate the results into a web-based user interface. This involves setting up a web application that will communicate with the ML models and weather API to display results to users.
For the integration of the website and API, the project implemented API endpoints to handle requests that make interactions with the Machine Learning models and weather API to fetch real-time weather data. In the end, use Pickle files to make predictions. The front-end framework tool called 'React' contains multiple components for providing user interfaces.

IV. FUTURE SCOPE
In machine learning, a systematic binary classification for the prediction of cloudburst has several potential applications and future uses. As a future prospect, we could integrate this project with both national and local early warning systems to timely inform people about looming cloudbursts so that they themselves can take preventive steps. It would enable disaster management authorities to predict the probability of a cloudburst with reasonable accuracy for decision-making and strategy implementation. Provides early warning to farmers, such as covering crops or adjusting irrigation timing, allowing them to protect their farms/crops from flood-related damage. It will assist in the planning and management of waterlogging and water diversion. It will tackle environmental-related problems caused by cloudbursts due to their potential to trigger landslides, soil erosion, and habitat destruction. Such data will also create impact on studies in the field of climate change embracing the extreme weather phenomena and would prove beneficial to scientists or researchers in understanding trends of weather phenomena. Road safety will be enhanced through predicting potentially dangerous cloudbursts leading to flooding and landslides, giving relevant alerts to the transport services.

Therefore, prediction can very effectively arrest the adverse impacts of a cloudburst by enhancing the facilities in extreme weather events.

V. RESULT

The implementation of the cloudburst prediction system using machine learning models , integration with a weather API and deployment on a web-based user interface has given promising outcomes.
Different models yield different accuracy, as shown in table:

Table 1. Comparison of model accuracy

Models	Training Accuracy	Testing Accuracy
SVM (Support vector machine)	86%	96%
Decision tree classifier	100%	92%
Logistic Regression	86%	96%

These accuracies show that the models were well-trained and capable of making accurate prediction on unseen data with SVM and Logistic regression showing high testing accuracy.
In this project, by integrating the trained models with weather API , the system can fetch real-time weather data and make prediction of cloudburst with high accuracy.

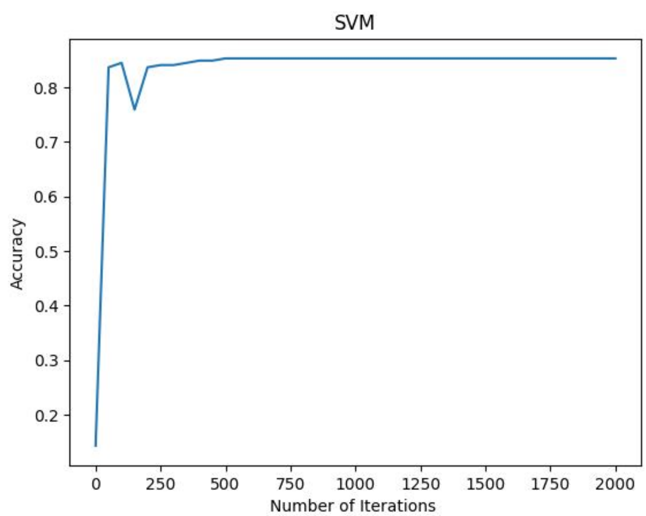

Fig 1. No. of iteration vs accuracy graph

The present weather API used in the project provides the data such as humidity, temperature, sea level pressure,dew point, cloud coverage and wind speed according cities present in India .
In this process of optimizing the machine learning models used for prediction cloudburst events, we described the relation between the number of iteration and accuracy of the models .
SVM model were trained with different number of iterations, ranging from 0 to 2000 in step of 50 using RBF kernel. The below graph shows the accuracy of the SVM model on the testing dataset as the number of iteration increase.
For more evaluation we plotted confusion matrix of this classification model which gave us breakdown of model's prediction.

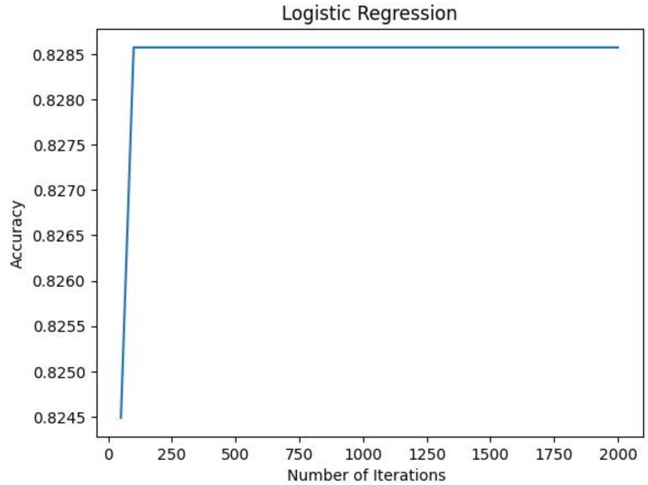

Fig 3. No. of iteration vs accuracy graph

Similarly , we analyzed the impact of the number of iteration on accuracy for Logistic regression. The graph below shows the accuracy trend.

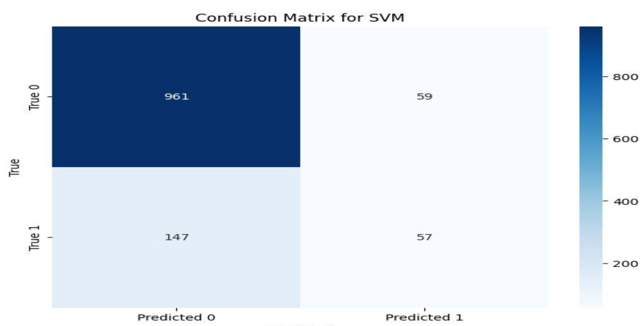

Fig 2.Confusion matrix for SVM

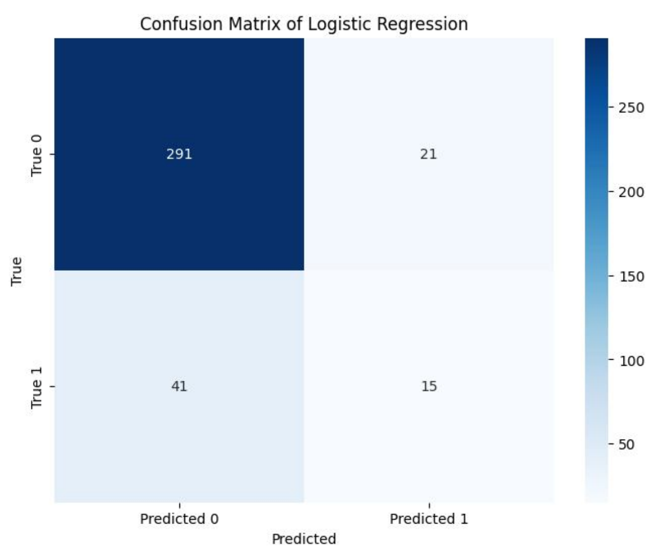

Fig 4. Confusion matrix of Logistic regression

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We have also included the confusion matrix for further analysis.

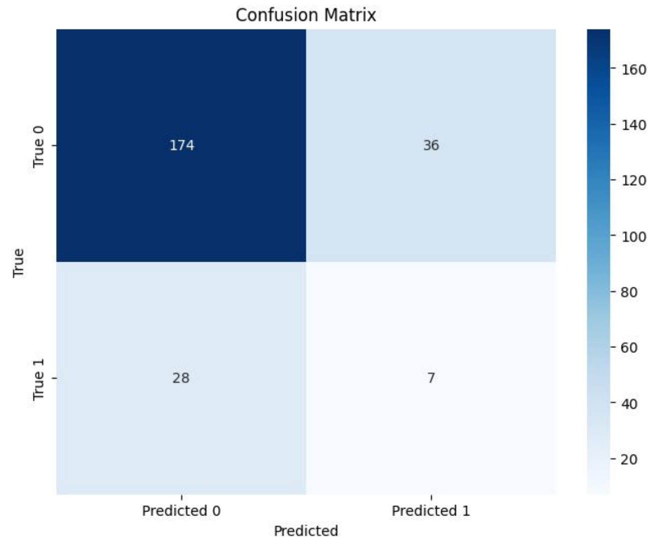


Fig 6 . Confusion matrix for Decision tree classifier

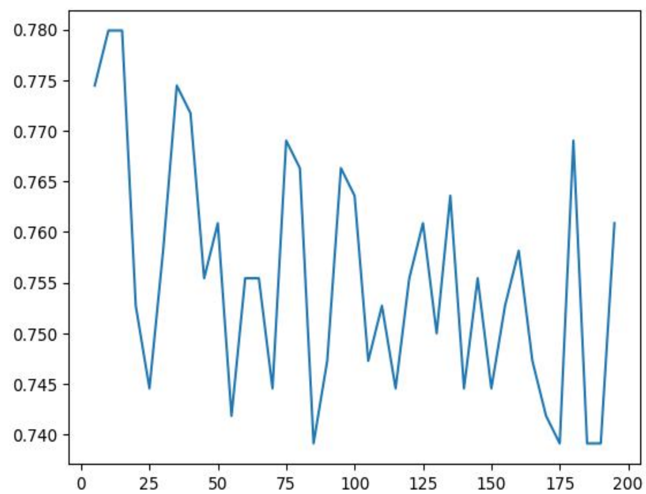


Fig 5. Depth vs accuracy graph

Similarly, we analyzed the variation accuracy with tree depth in Decision tree classifier. The graph below shows how the accuracy varies with tree depth of Decision tree classifier model, in similar way to previous algorithm, we plotted confusion matrix for this algorithm to interact with the prediciton system seamlessly. The UI fetch the real-time weather data using the weather API. User get real time weather informormation as shown in figure

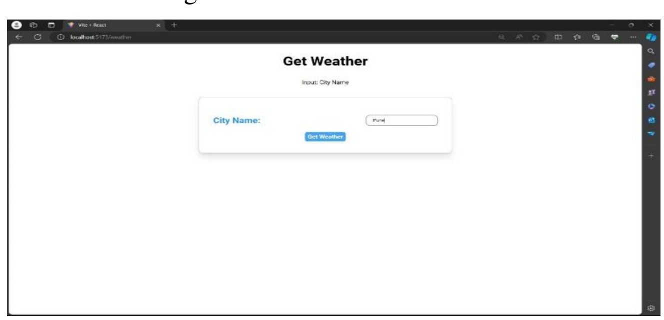


Fig 7. City Weather UI

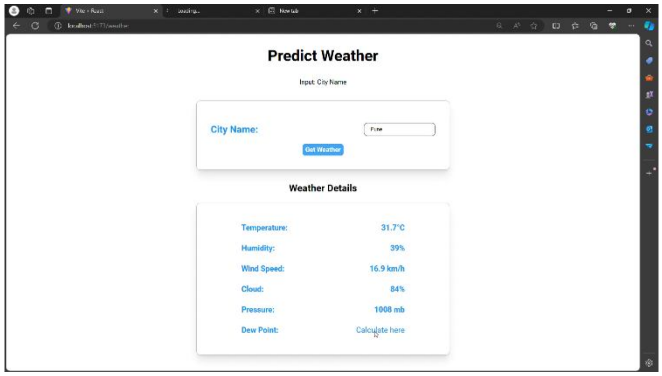


Fig 8. Weather detail UI

User put this weather data for the cloudburst prediction and by pressing predict ,the fetch the weather data ,process it and display the prediction on screen as shown in below figure

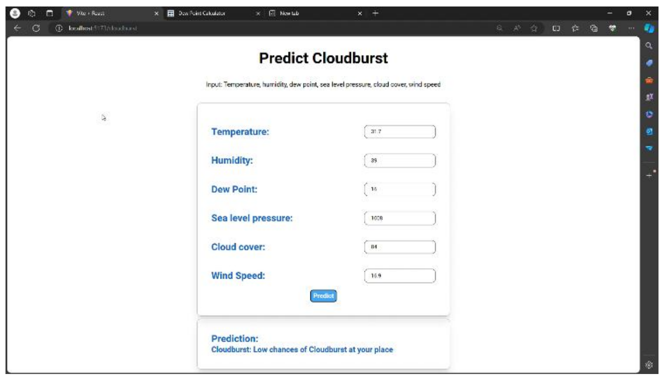


Fig 9. Prediction input data UI

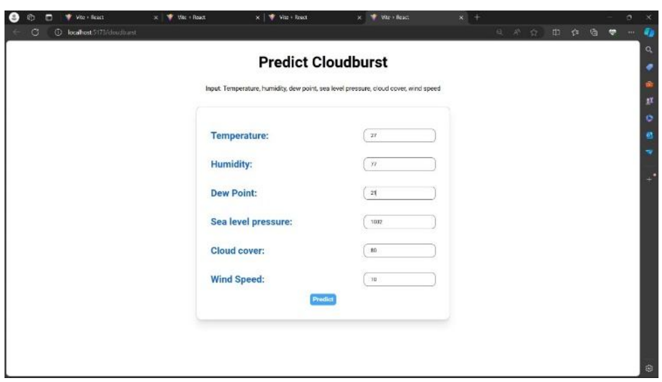


Fig 10. Prediction result

After all input on clicking predict button result is displayed on the under same UI which shown in below

VI. CONCLUSION

The emphasis of this project was to develop models that could forecast heavy rainfall occurrences, such as cloudbursts. The model built on the entire work consists of a cloudburst dataset possessing 6 important conditions indicating the cloudburst predictions to be generated by the model. The entire dataset reflects certain variations in terms of various parameters so that some imbalance occurs within that dataset. Proposed works described in this project were implemented by using three algorithms: Support Vector Machine (SVM), Decision tree classifier, Logistic Regression. Out of them, SVM gives a higher accuracy, so the flow of work is done with an SVM algorithm. The developed results forecast that cloudbursts are likely to be predicted with a larger accuracy percentage through the use of SVM algorithms.

VII. ACKNOWLEDGMENT

We would like to express my appreciation to everyone whose input along the way has assured the successful carrying out of this project entitled, Cloudburst Prediction System using Machine Learning.

We thank Professor Supriya Telsang whole heartedly for having guided our project. Her feedback and guidance were invaluable all through the project development and enhancement.

I greatly thank my teammates for their effort and commitment to this project. Each one put in his or her contribution with unique talents, which eventually carried us to this successful completion of the project. Our combined effort has made this experience fulfilling and enjoyable.

REFERENCES

[1] K. Bartwal, N. Pathak, J. Alexander, M. Aeri, S. A. Dhondiyal and S. Awasthi, "Rainfall Prediction Using Machine Learning," 2024 2nd International Conference on Disruptive Technologies (ICDT), Greater Noida, India, 2024, pp. 582-588.

[2] A. Sebastian, J. B. Thomas, R. Mathew, R. Jose and A. Manuel, "SkySentinel: Harnessing AI for Cloudburst Forecasting and Warning," 2023 International Conference on Circuit Power and Computing Technologies (ICCPCT), Kollam, India, 2023, pp. 214-219.

[3] D. Karunanidy, P. S. Rakshith, G. Sireesha, N. M, M. N and M. Sreedevi, "Cloudburst Prediction in India Using Machine Learning," 2023 6th International Conference on Recent Trends in Advance Computing (ICRTAC), Chennai, India, 2023, pp. 645-650.

[4] M. M. Hassan et al., "Machine Learning-Based Rainfall Prediction: Unveiling Insights and Forecasting for Improved Preparedness," in IEEE Access, vol. 11, pp. 132196-132222, 2023.

[5] K. G, Y. Sushmitha, K. L. Saranya, P. Naga Ramya Sri and P. Amulya, "Rainfall Prediction Using Deep Learning and Machine Learning Techniques," 2023 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI), Chennai, India, 2023, pp. 1-7.

[6] A. Shaji, A. R. Amritha and V. R. Rajalakshmi, "Weather Prediction Using Machine Learning Algorithms," 2022 International Conference on Intelligent Controller and Computing for Smart Power (ICICCSP), Hyderabad, India, 2022, pp. 1-5.

[7] G. Bhuvaneswar Reddy, J. Chethan, and M. Saravanamuthu, "Cloud Burst Forecast Using Expert Systems," International Research Journal of Engineering and Technology (IRJET), vol. 09, no. 08, pp. 1552-1555, Aug. 2022.

[8] N. Indra Kishor, S. K., and S. R., "Application of Cloudburst Prediction System: A Review," Industrial Engineering Journal, vol. 51, no. 07, 2022.

[9] N. Oswal, "Predicting Rainfall using Machine Learning Techniques," Australian Weather Data, 2022.

[10] A. Sunil, B. A. Binny, J. Benny, R. Rajeev, and A. Manuel, "An Intelligent Device to Predict Cloud Burst," International Journal for Research Trends and Innovation (IJRTI), vol. 7, no. 6, ISSN: 2456-3315, 2020.

[11] R. K. Grace and B. Suganya, "Rainfall prediction is one of the important techniques to predict climatic conditions in any country," Indian Dataset, 2020.

[12] A. Rahman, S. Abbas, M. Gollapalli, R. Ahmed, S. Aftab, M. Ahmad, M.A. Khan, A. Mosavi, Rainfall Prediction System Using Machine Learning Fusion for Smart Cities, Sensors (2022)

[13] N. Salaeh, P. Ditthakit, S. Pinthong, M.A. Hasan, S. Islam, B. Mohammadi, N.T. T. Linh, Long-Short Term Memory Technique for Monthly Rainfall Prediction in Thale Sap Songkhla River Basin, Thailand, Symmetry (basel). (2022)

[14] Rawat, K. S., Sahu, S. R., Singh, S. K., & Mishra, A. K. (2022). "Cloudburst analysis in the Nainital district, Himalayan Region" 2021.

[15] R. K. Grace and B. Suganya, "Machine Learning based Rainfall Prediction," 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2020, pp. 227-229

[16] R. R. Deshpande, "On the rainfall time series prediction using Multilayer Perceptron Artificial Neural Network," Int. J. of Emerging Technology and Advanced Eng., vol. 2, no. 1, pp. 148-153, 2012.

[17] R. R. Deshpande, "On the rainfall time series prediction using Multilayer Perceptron Artificial Neural Network," Int. J. of Emerging Technology and Advanced Eng., vol. 2, no. 1, pp. 148-153, 2012.

[18] A. Kumar, A. Kumar, R. Ranjan, and S. Kumar, "A rainfall prediction model using artificial neural network," Control and Syst. Graduate Research Colloq. (ICSGRC), pp. 82-87, 2012

[19] J. Abbot and J. Marohasy, "Application of Artificial Neural Networks to rainfall forecasting in Queensland, Australia," Advances in Atmospheric Sci.,vol. 29, no. 4, pp. 717-730, 2012.

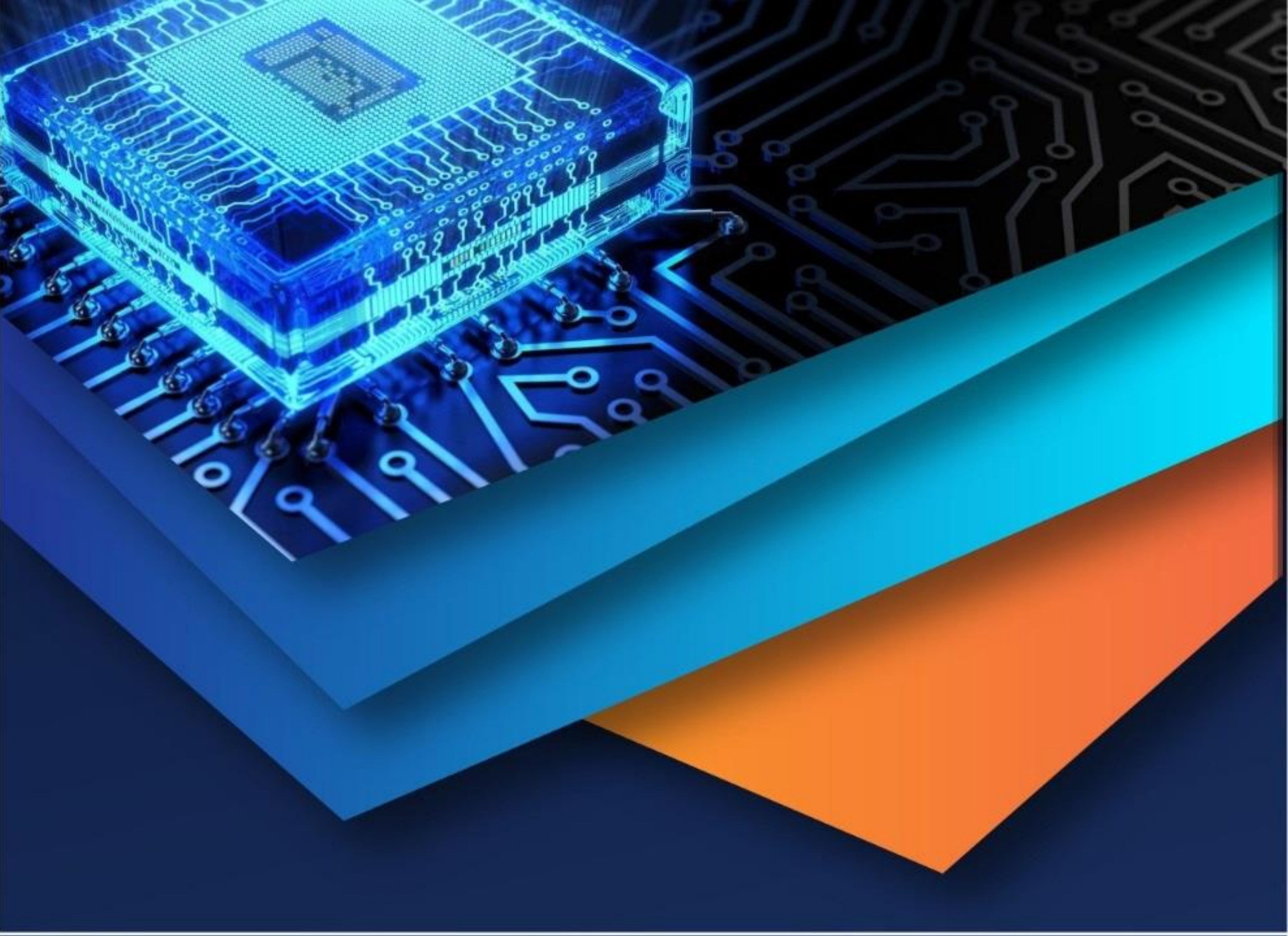
[20] J. Abbot and J. Marohasy, "Application of Artificial Neural Networks to rainfall forecasting in Queensland, Australia," Advances in Atmospheric Sci.,vol. 29, no. 4, pp. 717-730, 2012.

[21] G. Geetha and R. S. Selvaraj, "Prediction of monthly rainfall in Chennai using Back Propagation Neural Network model," Int. J. of Eng. Sci. and Technology, vol. 3, no. 1, pp. 211 213, 2011.

[22] K. K. Htike and O. O. Khalifa, "Rainfall forecasting models usingFocused Time-Delay Neural Networks," Comput. and Commun. Eng. (ICCCE), Int. Conf. on IEEE, 2010.

[23] S. Kannan , Subimal Ghosh, "Prediction of daily rainfall state in a river basin using statistical downscaling from GCM output", Springer-Verlag,July 2010.

[24] M.Kannan,S.Prabhakaran,P.Ramachandran,"Rainfall Forecasting Using Data Mining Technique", International Journal of Engineeringand Technology Vol.2 (6), 397-401, 2010.



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