# Weather Prediction Using Machine Learning

Mrs. Anjali Kadam, Shraddha Idhate, Gauri Sonawane, Rucha Sathe, Poonam Gundale *Department of Computer Engineering, Bharati Vidyapeeth's College of Engineering for Women,Savitribai Phule Pune University*
*Maharashtra , India*

***Abstract*—To predict the weather of a particular place at a specific time is known as Weather Forecasting. It is an application of science and technology. Weather forecast is more helpful for people as it predicts the possibilities of changes in weather conditions. The weather forecast can be done in many ways, collecting data and analysing it, image processing, by using methodologies like Normalization, Clustering, and cloud mask algorithms, etc. This paper is based on the process of Weather Forecasting. This system will be using Machine learning algorithms like Support Vector Machine(SVM), Time series based recurrent neural network, Random Forest, Naive Bayes, Artificial Neural Network, and Decision Tree. This system will accept data on current weather conditions such as current temperature, wind conditions, and humidity. It will predict the weather conditions of a certain location on a given day and time. This system will be useful in Air Traffic, Marine, Agriculture, Forestry, Military, and Navy, etc.**

***Keywords: Weather Forecasting, Weather prediction, machine learning, SVM, ANN, Naive Bayes.***

## I. INTRODUCTION

Weather forecasting is the process of predicting the weather of a certain day and time in a given location on the basis of its climate, atmosphere, and pattern. Weather forecasting is an application of science and technology which has been growing as many important factors depending on the weather forecast. Ancient weather forecasting methods usually relied on the observations of the patterns of events, also termed pattern recognition. Now, the weather forecast systems predict the weather based on parameters such as temperature, humidity, and wind. These days, Machine learning and Data science algorithms are of great help in predicting things on the basis of old information and patterns. Here in this system, we will be using Machine learning algorithms to predict the weather on the basis of collected parameters and datasets by accepting the location of the particular region. This system will be a website with an effective graphical user interface. The user will log in to the system using his user ID and password. The system will need the user to enter current information such as current temperature, humidity, and wind. The system will take this data and predict the weather from previous data in the database. This system will prove to be helpful in air traffic, marine, agriculture,military, navy, and forestry.

*Application:*

The analysis of the quantitative temporal weather data is the main objective of this empirically based work. In order to predict the weather, this study uses 10 surface weather parameters. The utility of certain meteorological variables for precision farming is considered when identifying them. Additionally, these surface parameters can be measured using a variety of sensors and a nearby weather station at a selected site.

*Applications of weather forecasting:*

After the invention of instruments for measuring atmospheric conditions in the 17th century, systematic meteorological records were kept. Undoubtedly, these early records were used primarily by people working in agriculture. Planting and harvesting can be better planned and executed more efficiently if all long-term weather patterns are predicted in advanced. A weather alert is a special type of short-term forecast. It is necessary to protect human life from abnormal weather. Weather warnings are issued by governments and military organizations around the world for all types of threatening weather events, such as hurricanes, typhoons, or tropical storms known as tropical cyclones, depending on locations.

During the 1920s and 1930s, weather forecasting developed into a crucial aviation instrument. In order to save time loss, potential damage, and fuel consumption in rough seas, many oceangoing commerce vessels and military ships employ optimum ship routing forecasts to plan their routes. Any observer who is familiar with the natural indicators in the sky can "foretell the weather" by interpreting the sky's appearance, the wind, and other local influences

A scientist can efficiently make the same determination using equipment at a single place. The data from numerous such observations gathered at various locations are used in the contemporary method of weather forecasting. Experts at various

weather stations swiftly exchange these and input them on a synoptic weather map. The patterns of pressure, wind, temperature, clouds, and precipitation at a certain moment are shown on these synoptic weather maps. Meteorologists can create the governing mathematical equations to explain these changes if they have a good understanding of how the atmosphere changes over time in response to different variables. Numerical models are created using these equations to determine how the atmosphere is changing and will look in the future. Forecasters can utilise the results from these models to help them when creating short- and long-term forecasts [1].

Different methods used in modern weather forecasting are:

(1) Synoptic weather forecasting:

This is the traditional and basic approach in weather forecasting. This method was used until the late 1950s. "Synoptic" means that observations of various meteorological elements are related to specific observation times. A weather map representing the state of the atmosphere at a point in time is therefore a synoptic map for meteorologists. To get an average view of changing weather patterns, modern meteorological centres produce a series of overview maps each day. An overview map like this is the basis for all general weather forecasts. The task of creating overview maps on a regular basis involves extensive collection and analysis of observational data collected from thousands of weather stations. Years of careful study of weather maps have formulated certain rules of thumb. These rules help forecasters estimate the speed and direction of movement of the weather system.

(2) Numerical methods:

Numerical methods involve a lot of mathematics. Numerical weather forecasting methods are currently used in modern weather forecasting. This approach is based on the idea that atmospheric gases are governed by many laws of physics. These laws of physics can be used to predict future weather conditions for current atmospheric conditions.

A set of mathematical formulas is used to develop a theoretical model of the general circulation of the atmosphere. These equations are used to describe atmospheric changes over time. These equations consider certain meteorological factors such as air movement, temperature, humidity, evaporation, from the ground, clouds, rain, snow, and the interaction of air with the ground and sea. A daily weather forecast model is one of them. A mobile phone displays these predictions.

(3) Statistical methods:

In addition to numerical weather forecast calculations, mainly statistical methods are used. These methods often complement numerical methods. Statistical methods use past records of weather data with the assumption that the future is a repeat of past weather. The main purpose of studying past weather data is to find aspects of weather that are good indicators of future events. Once these relationships are established, the correct data can be safely used to predict future states. Only global weather can be predicted with this method. It's especially useful when he only projects one side of weather at a time.

Network:

An increasing number of networks of telegraphed weather stations have made synoptic forecasts possible. It happened towards the end of the 19th century. The forecaster is able to produce synoptic weather maps of the upper atmosphere twice a day, based on radiosonde observations. Radar observations of the growth, movement, and features of such storms provide clues to their severity. Meteorological observation by satellite and aircraft. Numerous requirements and purposes are served by weather forecasting. Making informed decisions and making plans for the future are both made possible by it. Understanding atmospheric processes and subsequently making the most accurate weather predictions are the core goals of meteorologists. The ability to adapt to the climatic environment, which includes coping with common occurrences and withstanding unfavourable extremes, is a crucial component of life's existence. Therefore, using weather forecasts.

## II. LITERATURE REVIEW

From all the papers we have observed and studied that there are many factors which are responsible for weather prediction. Because daily weather data has multiple parameters such as temperature, humidity, rainfall amount, cloud distance and size, wind speed and direction, etc. All these parameters are non- linear, but they required to be processed together to determine temperature, rainfall, humidity or weather status for the future day. Such type of applications need complex models and can able to produce the required result by generating the patterns on its own

by performing self-learning using the training data given to the model. One of the paper was based on ANN algorithm which was supposed to give maximum accuracy, which considers above parameters and factors for weather change[1],[2],[4]-[7].

In the paper by Sumit Saha we studied an efficient temperature forecasting model proposed on hybrid Principal Component Analysis (PCA) empowered machine learning techniques. Datasets comprises of 8760 rows with seven attributes, for testing purpose they used 876 numbers of data. Overall operation has been performed into three phases. In first phase, PCA is applied to eliminate the irrelevant attributes from the datasets to improve the model accuracy. In second phase five machine learning algorithms: KNN, DT, RF, SVM & AdaBoost are used to predict the test datasets. On the last stage four statistical performance indicators: MAE, MSE, RMSE & Regression and training time used to identify the best fitted model [4].

A H M Jakaria et al preferred reliability in using AI learning models like genetic algorithms, neuro- fuzzy logic and neural networks. Among which neural networks is more preferred. In one of the papers based on smart weather prediction it was mentioned that the collected real weather data for the city of Nashville from wunderground.com , as well as nine more cities around Nashville: Knoxville, Chattanooga, Jackson, Bowling Green, Paducah, Birmingham, Atlanta, Florence, and Tupelo. For a given place and date, the wunderground API returns a list of weather observations data. The target variable is always the next day hourly temperature for city they chose was Nashville. The Training set contains two months of weather data starting from the 1st day of July, 2018. In contrast, the test set contains 7 days of data starting from September 1, 2018 and ending on September 7, 2018. Essentially, the trained model predicts hourly temperature of the 2nd September while inputting 1st September as test data. Similarly, temperature of September 3rd will be predicted based on data from September 2nd, andso on [6].

Uday Patkar et al compared and applied ANN and ARXNN (Autoregressive Neural Network with Exogenous Input) two different models on input data learning models and resulted in an application Introducing precipitation as an input in the ARX model was shown to slightly improve the prediction performance. We have studied researchers are onto developing learning models with utmost accuracy in prediction using historical and some researchers using real time API driven applications. Many algorithms were used as a part of model building like temperature with sampling error methods lilke RMSE, Mean, Standard Deviation, Artificial Neural Network (ANN), Auto-Regressive Models with eXogenous inputs (ARX), ARX-NN, Time series modelling, Random Forest Regression (RFR). In one of the papers the incorporated regression techniques used were Ridge Regression (Ridge), Support Vector (SVR), Multi-layer Perceptron (MLPR), Extra-Tree Regression (ETR),etc [7].

Such type of applications need complex models and can able to produce the required result by generating the patterns on its own by performing self-learning using the training data given to the model. One of the papers talks about smart weather forecasting where application restricted to only temperature using various cities dataset .In another paper 4 separate models were used for experimentation on single set of data of 48 hours consecutively , which they highly aimed to predict of some other geographical pressure areas. Previously, use of Python API for data collection from a particular city based Meteorological Institutes /stations were done , their prime try was to use API for multiple factors in which they were not successful. [7].

The researchers have used binary and multiclass classification models to predict weather conditions will occur within a certain time limit like 24 hrs, 48 hrs, weeks, months etc. The approach in the paper suggests a mechanism to identify the pattern that leads to failures. It is also observed that 80% of prediction is due to tropical temperature that varies city to city state wise, process issues and 20% is due to technical issues like incorporating and choosing learning models for application.

## III. EXISTING SYSTEM

The existing models have the ability to predict the weather but they precisely focus on the present weather conditions which can be obtained by observations from the ground, ships, aircrafts, radio sounds, doppler radar and satellites. Meteorologists generally use the combination of several different methods to come up with the predictions i. e. persistence forecasting, synoptic forecasting, statistical forecasting and computer forecasting. Now there are forecast systems that use the dominant technology for climate prediction.

## IV. PROPOSED SYSTEM

Our proposed model precisely focuses on data collection by fetching real-time data via APIs of various Meteorological Institutes /stations per city , but fetching with better and efficient time complexity including multiple factors with more accuracy and easy to understand GUI display of data on applications using weather forecasting updates on various platforms. The system is supposed to be as accurate as possible as it uses all the accurate, fast and proper machine learning algorithms. From all the papers we concluded using multiple learning models for our application as expecting the reliability of the input data to be more complex andmultiple in numbers.

We hope to cover our learning model with fulfilling essential requirements in user-based applications like weather alert adversaries considering present global warming climate changes, Navy and Marine board of panels, Military applications and the most important the agriculture sector that highly gets affected by climate change.

## V. CONCLUSION

1) In the era of global warming, nobody can guarantee when the climate will change and how it will affect major factors like agriculture, etc. So, it's necessary to know what is going to happen weather- wise to take the further steps. It is extremely important for accuracy and it widely benefits the economy.

2) Weather forecasting and weather monitoring are being more and more relevant these days, considering the latest technologies. The latest technologies used for weather forecasting include the machine learning algorithms. Data science algorithms play an important role in the predictionstoo.

3) This study demonstrates the use and application of the weather forecasting technology that will be helpful in the near future to build prediction machinery and websites that can be used to forecast the climate change of a certain location just by use of a little information about it. It can be an importanttool to expand the economy, worldwide.

## REFERENCES:


[1] Iseh. A. J., Woma. T. Y., 2013, Weather Forecasting Models, Methods and Applications, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 02, Issue 12 (December 2013)

[2] Zhu, Audrey & Pi, Halton. (2014). A Method for Improving the Accuracy of Weather Forecasts Based on a Comprehensive Statistical Analysis of Historical Data for the Contiguous United States. Journal of Climatology & Weather Forecasting. 2. 10.4172/2332- 2594.1000110.

[3] Afeera Saeed 110, Shamsa Muhammad 153, Muhammad SaadButt 153, Mohsin Aamir 134, Zohaib Khalid 16 Software Requirements Specification for ACCUWEATHER Version 1.0 FURC Date: 1 Jan, 2020

[4] Susmita Sena , Sumit Sahab , Sudipta Chakic , Payel Sahad , Pijush Dutta, Analysis of PCA based AdaBoost Machine Learning Model for Predict Mid-Term Weather Forecasting, October 2021

[5] P. Kuppusamy, K. Jayalakshmi, C. Himavathi, "Application of Machine Learning for Weather Forecasting Using Artificial Neural Networks," *International Journal of Computer Sciences and Engineering*, Vol.07, Issue.06, pp.24-27, 2019.

[6] A H M Jakaria, Md Mosharaf Hossain, Mohammad Ashiqur Rahman, Smart Weather Forecasting Using Machine Learning: A Case Study in Tennessee; 25 August 2020

[7] Prof, Uday Patkar, Mr. Sanskar Maske and Mr. Saffa Ahmad , Mr. Rushikesh Mengade, Mr. Gaurav Sadawarti; "Machine Learning for Weather Forecasting Using Freely Available Weather Data in Python"; August 2022

[8] Biswas, Munmun & Dhoom, Tanni & Barua, Sayantanu. (2018). Weather Forecast Prediction: An Integrated Approach for Analyzing and Measuring Weather Data. International Journal of Computer Applications. 182. 20-24. 10.5120/ijca2018918265.

[9] Swati Pandey, Shruti Sharma, Shubham Kumar, Kanchan Bhatt, Dr. Rakesh Kumar Arora, "Weather Forecast through Data Mining", International Journal of Scientific Research in Computer Science, Engineering and Information Technology(IJSRCSEIT), ISSN : 2456-3307, Volume 7 Issue 3, pp.90-95, May- June 2021.

[10] Rahul, Govind & Singh, Saumya & Dubey, Saumya. (2020). Weather Forecasting Using Artificial Neural Networks. 21-26. 10.1109/ICRITO48877.2020.9197993.