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A literature review on Improvement of Weather prediction by using Machine learning

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ABSTRACT:

Weather changes have a huge negative impact on the ecosystem and might suddenly precipitate natural disasters. There are numerous machine learning approaches and algorithms that can be used to forecast these changes and predict them early. It has been noted that, based on past research, there are a variety of additional ways to weather prediction. Various parameters such as temperature, humidity, wind direction, precipitation, evaporation, and so on are taken into account based on these. Following a review of developing techniques and datasets, a proposed system is developed. To anticipate efficient accuracy, decision tree, random forest algorithms are applied. Used algorithms allowing each individual learner to learn differently about various parameters and increasing accuracy. The study indicated that a proactive catastrophe recognition system should be implemented to avert future loss of human lives and environmental consequences.

Keywords: Weather Prediction, forecast accuracy

Introduction:

This paper gives a brief summary of weather forecast trends, challenges, and the nature of their occurrence, as well as existing and promising solutions. The neural network architecture is offered as a possible method for improving the accuracy of weather forecasts produced by various regional models. This design enables for the prediction of atmospheric model forecast errors as well as their subsequent corrections. Experiments with various histories of regional model errors are performed. It is demonstrated that the proposed architecture allows for the improvement of a weather forecast.

The initial attempt at weather prediction necessitated a larger workforce. Weather prediction has returned to the early models in terms of similarity, thanks to the development of powerful and better modeling tools. The forecast equations in Weather Prediction are then simple-basic equations. Because equations dictate how meteorological variables change over time, if the initial state of the atmosphere is known, equations may be used in our project to anticipate new values for those variables in the future. Weather data is gathered for a short-range over a specific region at a specific station. The results suggest that it can more precisely and reliably forecast meteorological conditions.

In the current era of machine learning and technologies, weather prediction is rapidly gaining ubiquity. Predicting the climate for an extended period of time is critical. Decision trees, K-NN, and Random Forest etc. algorithms are valuable assets that have been used in a variety of prediction applications, such as flood prediction and storm detection. The decision tree, K-NN, and random forest method calculations are used in this research to present a simple technique for weather prediction of future years by employing historical data analysis, with the best accuracy result of these three algorithms. Weather prediction is important in everyday life, and the forecast in this study is based on rain variations in a specific area.

All of these methods compute mean values, medians, confidence intervals, and probability, as well as plot the differences between the three algorithms' plots, and so on. Finally, utilizing the algorithms used in this study, we can forecast whether it will rain or not. The dataset is totally dependent on the weather of a given area including a few objects like a year, month, forecasted values, and so on.

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What is the Weather Forecast?

Weather forecasting is the use of science and technology to forecast atmospheric conditions for a specific location and time. For millennia, people have sought to predict the weather informally, and systematically since the nineteenth century. Weather predictions are created by gathering quantitative data on the current state of the atmosphere, land, and ocean, and then applying meteorology to project how the atmosphere will change at a certain location.

Weather forecasting is currently based on computer-based models that take many atmospheric aspects into account, rather than being estimated manually based on changes in barometric pressure, present weather conditions, and sky condition or cloud cover. Pattern recognition skills,

teleconnections, knowledge of model performance, and understanding of model biases are still required for selecting the best potential forecast model on which to base the forecast.

The chaotic nature of the atmosphere, the massive computational power required to solve the equations that describe the atmosphere, land, and ocean, the error involved in measuring initial conditions, and an incomplete understanding of atmospheric and related processes all contribute to forecasting's inaccuracy. As a result, as the time difference between now and the time for which the forecast is being produced grows, projections become less accurate. The usage of ensembles and model consensus can help to reduce the error and increase the forecast's confidence level.

Weather forecasts have a wide range of applications. Weather warnings are crucial forecasts because they safeguard people and property. Agricultural forecasts based on temperature and precipitation are critical, and traders in commodities markets rely on them. Many people use weather forecasts to decide what to wear on a given day on a daily basis. Because heavy rain, snow, and wind chill significantly limit outdoor activities, forecasts can be used to schedule activities around these phenomena, as well as to prepare ahead and survive them.

What is the use of weather prediction?

Weather prediction's purpose is to give information that people and organisations can use to reduce weather-related losses and improve societal advantages, such as life and property protection, public health and safety, and economic prosperity and quality of life.

METHODOLOGY:

As additional weather satellites are deployed into orbit and technology advances, the science of weather forecasting improves. Satellites, ships, aeroplanes, weather stations, buoys, and gadgets dropped from planes or weather balloons are all used by meteorologists. There are two primary methods of forecasting used by climatologists and meteorologists: deterministic and probabilistic, both of which have various subsets. A deterministic prediction forecasts a specific event that will occur at a certain time and location, such as a hurricane's arrival or a tornado's touchdown.

Probabilistic weather predictions indicate the likelihood of weather occurrences occurring in a specific place over a specific time period, such as a storm lasting a few days. Climate change caused by excess greenhouse gases in the atmosphere, on the other hand, frustrates forecasters since it becomes more difficult to predict whether that varies due to any outside influence that does not follow seasonal trends or averages.

Climatology Method:

The climatology approach is a simple way of forecasting the weather. Meteorologists utilize this strategy after computing the averages of meteorological data collected over several years. They forecast the weather for a given day and based on previous weather conditions for that day in the preceding several years.

For example, a forecaster could look at Labor Day averages to estimate the weather for the forthcoming holiday. The climatology method works when weather patterns remain consistent, but it is not the ideal strategy for predicting the weather in situations where outside causes affect the weather often, such as climate change due to global warming.

How Does Climatology work?

Climatology is the study of weather patterns throughout time. The work is similar to that of meteorologists, but it is done over a much longer period of time, examining trends across months, years, or even centuries.

Typical work activities

- To predict long and short-scale patterns, researchers examine and interpret data, maps, reports, pictures, and charts.
- Predicting trends with computer models
- Creating projections and briefings for clients in the industrial, commercial, and government sectors
- Data from weather stations, satellites, or radar stations are collected and distributed to the media.
- Making scientific presentations and preparing for them
- Problems such as global warming, agriculture, and natural disasters can all benefit from using knowledge.
- Investigating the factors that cause weather events
- Analyzing historical climate data to aid in forecasting future developments
- Dealing with demands for information and interviews from the media

Analog Method:

When predicting the weather, the analog approach is difficult to utilize because it needs to identify a day in the past with weather that is comparable to the current forecast, which is tough to do. Consider the following scenario: the current forecast predicts a warm day with a cold front approaching the forecast area.

A similar day occurred in the previous month when a warm day was followed by the arrival of a cold front, which resulted in the formation of thunderstorms later in the day. The forecaster could use the analog approach to anticipate the same type of weather, but even minor variances between the past and the present can influence the outcome, thus the analog method may not be the best option.

Persistence and Trends Method:

Because it relies on past trends, the persistence and trends method requires little to no talent to predict the weather. In an ideal world, the environment changes slowly, resulting in a forecast for tomorrow that is identical to today, with a nod to the climate's norm for the season. This method merely requires you to be aware of current situations and conditions, as well as knowledge about the region's climate averages.

Numerical Weather Prediction Method:

Computers are used to predict the weather in numerical weather prediction. Meteorologists use massive supercomputers with software forecasting models to generate weather predictions based on many atmospheric parameters like temperatures, wind speed, high- and low-pressure systems, rainfall, snowfall, and other factors.

The weather person examines the data in order to determine the day's weather forecast. The accuracy of the forecast is determined by the methods utilised by the computer software to forecast the weather. Errors occur when parts of the equations are not precise. Overall, when compared to other methodologies, numerical weather prediction provides the best means of forecasting forthcoming meteorological conditions.

Objective:

1. To research a variety of forecasting strategies for predicting future weather.
2. To predict the condition of a specific weather event in the near future.
3. To provide a weather forecasting platform.

Conclusion

The suggested study work has established a model for weather prediction that can be used to improve performance without incurring significant additional costs, as well as reducing prediction variation. Weather plays an important role in our daily lives, and it would be difficult to arrange daily activities without the help of meteorologists and forecasters. Weather forecasters and meteorologists can predict the weather and its potential changes, yet the weather is still unpredictable.

In this study, we used neural network architecture to improve forecasting by addressing regional numerical model flaws. Hopefully, this approach may be used to forecast other continuous meteorological data. We ran tests with a variety of error histories to determine the number of epochs. We demonstrated that the proposed architecture facilitates this.

The project's goal is to use a mathematical model to anticipate weather forecasting. The early design was to see if a larger workforce was required numerically. Numerical Weather Prediction has made a comeback thanks to the advancement of powerful computers and improved technologies. The rainfall of a specific place is predicted using characteristics. Due to frequent changes in the climate and ecology, predicting the weather of a specific place is a difficult task. A mathematical model based on time-series data is employed in our project work to anticipate weather predictions for a certain location over a period of time.

The system was tested in an indoor setting, and the values of the parameters were recorded. In the Jupyter notebook environment, models were trained with pre-recorded parameter values and used to forecast weather parameters in a real-time setting. The model's output is compared to previous efforts in the literature, and the suggested system outperforms them somewhat in terms of accuracy. Furthermore, the system may be customized for commercial usage, and it has numerous uses in smart homes, buildings, sports, and hospitals, among others.

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