

PREDICTION OF WEATER FORECAST CONDITIONS FOR SMART AGRICULTURE SUPPORTED BY MACHINE LEARNING

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Technology Degree in Information technology

by

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**DEPARTMENT OF COMPUTER SCIENCE AND
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SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY (DEEMED TO
BE UNIVERSITY)**

Accredited with Grade "A" by NAAC JEPPIAAR NAGAR, RAJIV

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **ABINAYA A (38120004), ANNA GREETA TITUS (38120009)** who carried out the project entitled "**PREDICTION OF WEATHER FORECAST CONDITIONS FOR SMART AGRICULTURE SUPPORTED BY MACHINE LEARNING**" under my supervision from **NOVEMBER 2021 to MAY 2022**.

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DECLARATION

I, **ABINAYA A (38120004)** hereby declare that the project report entitled “ **PREDICTION OF WEATHER FORECAST CONDITONS FOR SMART AGRICULTURE SUPPORTED BY MACHINE LEARNING**” done by me under the guidance of **Dr.V.NIRMALRANI** at “sathyabama institute of science and technology (Deemed to be university), Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai-600119” is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Information technology.

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ABSTRACT

This paper outlines a study that looked consider how machine learning regression techniques could be applied to forecast weather in agricultural fields for smart irrigation systems, crop selection, and agriculture. Farmers are increasingly relying on harvest time judgments in order to make sound crop management and financial decisions. Accurate crop output estimates can be immensely beneficial to decision-makers. In either case, using more weather-related features based on the harvest model will improve forecasting efficiency. In order to estimate crop production models, we developed an adaptable deep neural network architecture to analyse weather-related data in this article. The proposed model aims to forecast future harvest models using meteorological data from the previous year. By estimating future crop models based on weather-related data, farmers can take the necessary precautions or discontinue growing specific crops. The suggested model is designed to anticipate future crop models using weather-related data from the preceding year. As a result, farmers would be able to take appropriate adjustments or stop cultivating specific crops depending on future crop models projected using weather-related data. More weather-related information based on the harvest model will improve forecasting performance in either instance. Using meteorological data from the previous year, the suggested model seeks to anticipate future harvest models. Farmers can take the required safeguards or stop growing specific crops by forecasting future crop models based on weather-related data. The proposed model uses weather-related data from the previous year to forecast future crop models. As a result, based on future crop models forecasted using weather-related data, farmers would be able to make suitable adjustments or discontinue cultivating specific crops.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPANSION
NN	NEURAL NETWORK
CNN	CONSTITUTIONAL NEURAL NETWORK
SVR	SUPPORT VECTOR REGRESSION
NWP	NUMERICAL WEATHER PREDICTION
GBDT	GRADIENT BOOSTING DECISION TREE
DNN	DEEP NEURAL NETWORK
ANN	ARTIFICIAL NEURAL NETWORK
WSN	WEIRELESS SENSOR NETWORK
XG BOOST	EXTREME GRADIENT BOOSTING

CHAPTER-1

INTRODUCTION

Agriculture is extremely important to the world economy. As the human population grows, the agriculture sector will be put under additional strain. Agri-Technology and precision farming, dubbed "digital agriculture" by some, are two new scientific fields that make use of data. Agriculture has a vital role in the global economy. With the world's population growing, it's more important than ever to understand global agricultural output in order to address food security concerns and mitigate the effects of climate change. Crop yield forecasting is a major issue in agriculture. Weather factors such as rapid rainfall, temperature differences, pesticides, and other factors have a significant impact on agricultural yield. The weather forecast is a significant aspect that influences crop productivity. As a result, the weather forecast is anticipated, and plantings are selected based on the forecast. The use of science and technology to forecast the future atmospheric conditions of certain region and time is known as weather forecasting. People have been attempting to predict the weather informally for thousands of years, particularly since the nineteenth century. Weather forecasts are made by collecting data on the current state of the atmosphere in a specific location and then using weather to predict how the atmosphere will change. Individual input is still required to select the best predictive model for forecasting.

Farms are a key consumer of private weather forecasting organizations, and the benefits of better weather forecasting for agriculture are evident. The optimal time to plant, fertilize, irrigate, and harvesting crops is determined by the weather. Accurate weather data for every region of the farm can help farmers increase their productivity. Weather forecasting is useful not just for growing crops, but also for exporting them promptly. Many rural roads in the globe are dirt, and farmers must know when they are safe to use them. We use data from a specific location to estimate future weather conditions, assisting farmers in selecting the appropriate crops and irrigation methods based on changing weather circumstances. There are several methods for forecasting the weather, ranging from glancing up at the sky, which was used in ancient times, to complex computational models. In this situation, we use it by comparing weather patterns and predicting which crops will thrive in that environment we jumbled the crops and advised the best one to be

planted sown based on the user's choices. Deep learning are a type where machine learning makes use of multi-layer neural networks (NNs). The study's principal deep learning technique was the convolutional neural network (CNN). In applications that need a large amount of data, such as picture recognition, CNNs are one of the most often utilized algorithms for showing complex operations and performing design recognition

Weather is a common natural occurrence that has a significant daily impact on a large percentage of the global human population; in other words, weather events are the most commonly encountered natural occurrences that have a significant daily impact on a large percentage of the world's man or woman population. There are numerous factors that influence the forecasting of weather events in a certain region, and it is impossible to predict weather occurrences precisely. Changing the values of these parameters has a big impact on the weather. Geological conditions also have a significant impact on these values. As a result, scientists, researchers, and other weather forecasters face a challenging task in predicting accurate weather events for a certain time and location. The topic of weather event forecasting has drawn numerous experts from various study societies because to its direct repercussions on human existence around the world.

Weather forecasting systems are the most complex equation-type systems that require a sophisticated computer system to solve. On a regular basis, satellites, weather stations, and numerous devices and sensors in various geographical places throughout the world acquire a tremendous amount of weather-related data. These data sets can be used to forecast weather for every point on the planet. For a wide range of locations, weather specialists now provide forecasts for the next 24, 48, and 72 hours, as well as up to one week. These reports are now fairly accurate, though it is astonishing how quickly conditions in a small area can change. The weather circumstances There's a chance of ice storms, fog, and snow. Storms are extremely dangerous phenomena that can occur on the roads, resulting in a host of road safety issues. The embedded system is utilized to produce very short-term local location forecasting, whereas the traditional weather prediction model provides an influential system intelligent to give indications or suggestions about the weather progression in the hours/days ahead in a vast geographical location. This type of long- and short-term planning is possible

because to powerful prediction algorithms.

Weather event prediction has grabbed the interest of countless researchers and scientists from various research institutes due to its global impact. Large weather surveillance datasets are now widely available, and the recent introduction of data, knowledge, and computer science tools has prompted a wave of new studies targeted at identifying hidden patterns in enormous datasets for weather event forecasting around the world. Predicting weather events is an exciting research issue with a wide range of possible applications in agriculture, tourism, aviation, and other sectors.

In recent years, several important attempts at weather event prediction have been performed, with good results, using various arithmetical modelling methods such as machine learning. Due to the availability of a huge number of weather event datasets around the world and weather event prediction models that can employ unknown structural prototypes in the weather event datasets, weather forecasting has become increasingly significant in comparison to other difficulties. A lot of important hard work was done in the domain of weather forecasting in the last decade, and the results were effectively published, using various arithmetical modelling methods and machine learning algorithms.

According to the experts, weather forecasts are frequently divided into four categories. The first category is now casting. In Now casting, you can see the weather forecast for the next few hours. The second category is short-term forecasting. This category includes weather forecasting for 1-3 days, with the major goal of this forecasting being to forecast weather for the next 24 hours. The third type of forecasting is medium-range forecasting, which covers a period of four to ten days. Long-term/extended-range forecasting is the fourth and final category of forecasting, which encompasses a time period ranging from 10 days to months and seasons.

OBJECTIVE

Agriculture plays a vital role in the global economy. With the world's population growing, it's more important than ever to understand global agricultural output in order to address food security concerns and mitigate the effects of climate change. Crop yield forecasting is a major issue in agriculture. Weather elements like as rain, temperature, pesticides, and other factors have a significant impact on agricultural productivity. The weather forecast is an important factor that affects agricultural productivity. As a result, the weather forecast is forecasted, and crops are chosen based on the forecast.

MOTIVATION

Weather forecasts are made by obtaining data on the current state of the atmosphere in a certain place and then using weather to predict how the atmosphere will change. Individual input is still necessary to select the best forecasting prediction model. The benefits of better weather forecasting for agriculture are evident, and private weather forecasting services serve a huge number of farms. The optimal time to plant, fertilize, irrigate, and harvest crops is determined by the weather. Farmers can benefit from accurate weather data for each farm region in order to boost productivity. Weather forecasting is useful not just for growing crops, but also for quickly exporting them. There are many dirt roads in rural areas around the world, and farmers must know when it is safe to use them. Weather forecasting can be done in a variety of ways, ranging from staring up at the sky, as in ancient times, to employing complex computational models. In this case, we use it to compare weather patterns and forecast which crops will thrive in that climate. Based on the user's choices, we mixed the crops and indicated the ideal one to plant. Deep learning is a type of machine learning that employs multi-layer neural networks (NNs). The study's main deep learning technique was the constitutional neural network (CNN). In applications that need a large amount of data, such as picture identification, CNNs are one of the most often used algorithms for displaying complex operations and completing design recognition.

1.3 PROBLEM STATEMENT

Smart agricultural sensing has recently provided significant benefits in practical applications, making it one of the most important and beneficial technologies available. The forecast of climate data, such as temperature, wind speed, and humidity, allows outdoor plantation farms to plan and control agricultural operations to improve crop yield and quality. However, because the sensing data is complicated, nonlinear, and has several components, it is difficult to reliably anticipate climate changes.

1.4 JUSTIFICATION OF THE PROBLEM

Climate change has a direct or indirect impact on every element of human life. Every aspect of human life is influenced by the weather. It has a greater impact in other domains, such as agriculture, irrigation, transportation, economy, telecommunications, traffic, air pollution, and military industries.

Rain is the most basic agroclimatology ingredient, it is critical to assess the weather for farming and agriculture in India, particularly in Rajasthan's arid region. Water intake and farming civilization are both reliant on monsoon weather because it is a tropical country. It empowered farmers, agriculturists, disaster management institutes, scientists, and other connected organizations to identify with the natural calamity and plan for the future.

The first phase in the study is to collect weather data after receiving authorization from the meteorological agency. After that, perform data preprocessing in order to analyze the data. Examine the results of existing models that have been used to analyze data. Create a dynamic model selection method or make adjustments to an existing model. Implement and test the proposed technique/performance algorithms in real-world scenarios. Compare the proposed model's/performance techniques against that of other models.

CHAPTER 2 LITERATURE

REVIEW

Abhinav Sharma et al, Arpit Jain et al, Prateek Gupta, V. Chowdary et al proposed that agriculture plays a vital role in the economic growth of any country. With the increase of population, frequent changes in climatic conditions and limited resources, it becomes a challenging task to fulfil the food requirement of the present population. Precision agriculture also known as smart farming have emerged as an innovative tool to address current challenges in agricultural sustainability. The mechanism that drives this cutting edge technology is machine learning (ML). It gives the machine ability to learn without being explicitly programmed. ML together with IoT (Internet of Things) enabled farm machinery are key components of the next agriculture revolution. In this article, authors present a systematic review of ML applications in the field of agriculture. The areas that are focused are prediction of soil parameters such as organic carbon and moisture content, crop yield prediction, disease and weed detection in crops and species detection. ML with computer vision are reviewed for the classification of a different set of crop images in order to monitor the crop quality and yield assessment. This approach can be integrated for enhanced livestock production by predicting fertility patterns, diagnosing eating disorders, cattle behaviour based on ML models using data collected by collar sensors, etc. Intelligent irrigation which includes drip irrigation and intelligent harvesting techniques are also reviewed that reduces human labour to a great extent. This article demonstrates how knowledge-based agriculture can improve the sustainable productivity and quality of the product[1].

P.P. Pawade et al, Dr. A.S. Alvi et al proposed that The process of modernization of agriculture reduces the laborious work and motivates the farmers for doing smart farming. Artificial Intelligence plays a vital role in the smart farming concept. Artificial Intelligence is a trending topic for the advancement of the agriculture field. Machine Learning is one of the subareas of Artificial Intelligence. Machine Learning would ensure the increase of crop quality and quantity by using supervised and unsupervised techniques. Some of the application areas of machine learning are given i.e. automated irrigation systems, agricultural drones for field analysis, crop monitoring systems, precision agriculture, animal identification and health monitoring, etc. This

paper gives an overview of crop disease identification, weed detection, yield prediction, soil management [2].

Gaurav Verma et al, Pranjul Mittal et al, Shaista Farhreen et al This paper implements the real time weather prediction system that can be used in number of applications like homes, industries, agriculture, stadiums etc. for predicting the weather information. The system utilizes a temperature and humidity sensor i.e. DHT11 and a light intensity sensor i.e. LDR. The sensed data from the sensors are uploaded to a Thing Speak cloud server using NodeMCU and ESP8266-01 module. The data is also displayed on a customized HTML webpage for monitoring the real time values. A logistic regression model is used for setting up the machine learning environment. This model is trained using the pre- recorded values of sensor data. Further, NodeMCU records the data from sensors i.e. temperature, humidity and light intensity and then the values are transferred to the Jupyter notebook that utilizes a python environment. This real time data is used to test the model and prediction is done for a particular value by blinking the led connected to NodeMCU. [3].

Hu du et al, Eva Lucas Segarra et al, Carlos Fernandez et al proposed that obtaining site-specific high accuracy historical and near-future weather data have always been a challenging task for building simulation community to do either building performance analysis or predictive building control. Although ‘typical’ (such as TRY/TMY) or ‘extreme’ (such as DSY/DRY/EPW) weather files are made available, they often do not fit the purpose of studies. This paper demonstrates a novel approach to obtain real-time current and forecast weather in EPW format for building simulation using the free online toolchain. It is the first attempt to create weather API (Application programming interface) designed explicitly for building simulation community [4].

Jonathan A et al. Weyn et al, Dale R. Durran et al, Rich Caruana et al presents a significantly improved data-driven global weather forecasting framework using a deep convolutional neural network (CNN) to forecast several basic atmospheric variables on a global grid. New developments in this framework include an off-line volume-conservative mapping to a cubed-sphere grid, improvements to the CNN architecture and the minimization of the loss function over multiple steps in a prediction sequence. The cubed-sphere remapping minimizes the distortion on the cube faces on which convolution operations are performed and provides natural boundary conditions for padding in the CNN. Our improved model produces weather forecasts that are

indefinitely stable and produce realistic weather patterns at lead times of several weeks and longer. For short- to medium-range forecasting, our model significantly outperforms persistence, climatology, and a coarse-resolution dynamical numerical weather prediction (NWP) model. Unsurprisingly, our forecasts are worse than those from a high-resolution state-of-the-art operational NWP system. Our data-driven model is able to learn to forecast complex surface temperature patterns from few input atmospheric state variables. On annual time scales, our model produces a realistic seasonal cycle driven solely by the prescribed variation in top-of-atmosphere solar forcing. Although it currently does not compete with operational weather forecasting models, our data-driven CNN executes much faster than those models, suggesting that machine learning could prove to be a valuable tool for large-ensemble forecasting [5].

R. Sharma et al , S. S. Kamble et al, A. Gunasekaran et al, V. Kumar et al and A. Kumar et al, proposed that agriculture plays an important role in sustaining all human activities. Major challenges such as overpopulation, competition for resources poses a threat to the food security of the planet. In order to tackle the ever-increasing complex problems in agricultural production systems, advancements in smart farming and precision agriculture offers important tools to address agricultural sustainability challenges. Data analytics hold the key to ensure future food security, food safety, and ecological sustainability. Disruptive information and communication technologies such as machine learning, big data analytics, cloud computing, and blockchain can address several problems such as productivity and yield improvement, water conservation, ensuring soil and plant health, and enhance environmental stewardship. The current study presents a systematic review of machine learning (ML) applications in agricultural supply chains (ASCs). Ninety three research papers were reviewed based on the applications of different ML algorithms in different phases of the ASCs. The study highlights how ASCs can benefit from ML techniques and lead to ASC sustainability. Based on the study findings an ML applications framework for sustainable ASC is proposed. The framework identifies the role of ML algorithms in providing real-time analytic insights for pro-active data-driven decision-making in the ASCs and provides the researchers, practitioners, and policymakers with guidelines on the successful management of ASCs for improved agricultural productivity and sustainability [6].

S. Ray et al, proposed that machine learning is predominantly an area of Artificial

Intelligence which has been a key component of digitalization solutions that has caught major attention in the digital arena. In this paper author intends to do a brief review of various machine learning algorithms which are most frequently used and therefore are the most popular ones. The author intends to highlight the merits and demerits of the machine learning algorithms from their application perspective to aid in an informed decision making towards selecting the appropriate learning algorithm to meet the specific requirement of the application [7].

J. Binas et al, L. Luginbuehl et al and Y. Bengio et al proposed that modern machine learning methods have achieved superhuman performance on a variety of tasks, simply learning from the outcomes of their actions. We propose a path towards more sustainable agriculture, considering plant development an optimization problem with respect to certain parameters, such as yield and environmental impact, which can be optimized in an automated way. Specifically, we propose to use reinforcement learning to autonomously explore and learn ways of influencing the development of certain types of plants, controlling environmental parameters, such as irrigation or nutrient supply, and receiving sensory feedback, such as camera images, humidity, and moisture measurements. The trained system will thus be able to provide instructions for optimal treatment of a local population of plants, based on non-invasive measurements, such as imaging [8].

T. Anjali et al, K. Chandini et al, K. Anoop et al and V. L. Lajish et al, proposed weather prediction is one of the most important research areas due to its applicability in real-world problems like meteorology, agricultural studies, etc. We propose a method for temperature prediction using three machine learning models - Multiple Linear Regression (MLR), Artificial Neural Network (ANN) and Support Vector Machine (SVM), through a comparative analysis using the weather data collected from Central Kerala during the period 2007 to 2015. The experimental results are evaluated using Mean Error (ME), Mean Absolute Error (MAE), Root Mean Square Error (RMSE) and Correlation Coefficients (CC). The error metrics and the CC shows that MLR is a more precise model for temperature prediction than ANN and SVM [9].

K. G. Liakos et al, P. Busato et al, D. Moshou et al, S. Pearson et al and D. Bochtis et al proposed that machine learning has emerged with big data technologies and high-performance computing to create new opportunities for data intensive science in the multi-disciplinary agri-technologies domain. In this paper, we present a comprehensive review of research dedicated to applications of machine learning in agricultural

production systems. The works analyzed were categorized in (a) crop management, including applications on yield prediction, disease detection, weed detection crop quality, and species recognition; (b) livestock management, including applications on animal welfare and livestock production; (c) water management; and (d) soil management. The filtering and classification of the presented articles demonstrate how agriculture will benefit from machine learning technologies. By applying machine learning to sensor data, farm management systems are evolving into real time artificial intelligence enabled programs that provide rich recommendations and insights for farmer decision support and action [10].

CHAPTER3

METHODOLOGY

3.1.AIM

The main objective of this project is to predict the weather for smart agriculture using machine learning.

3.2.SCOPE

Agriculture has a vital role in the global economy. Agriculture will be put under even more strain as the human population expands. Precision farming and Agri-Technology, termed "digital agriculture" by some, are two new scientific fields that employ data. Agriculture is extremely important to the world economy. With the world's population expanding, it's more critical than ever to comprehend global agricultural output in order to address food security concerns and prevent climate change's effects. In agriculture, crop yield forecasting is an important challenge. Rapid rainfall, temperature fluctuations, insecticides, and other environmental conditions all have an impact on agricultural productivity. The weather forecast is an important factor that affects agricultural productivity. As a result, the weather forecast is anticipated, and crops are chosen in accordance with it. Weather forecasting is the application of science and technology to predict the future and the atmospheric conditions of a specific location and time. For thousands of years, people have attempted to predict the weather informally, particularly since the nineteenth century.

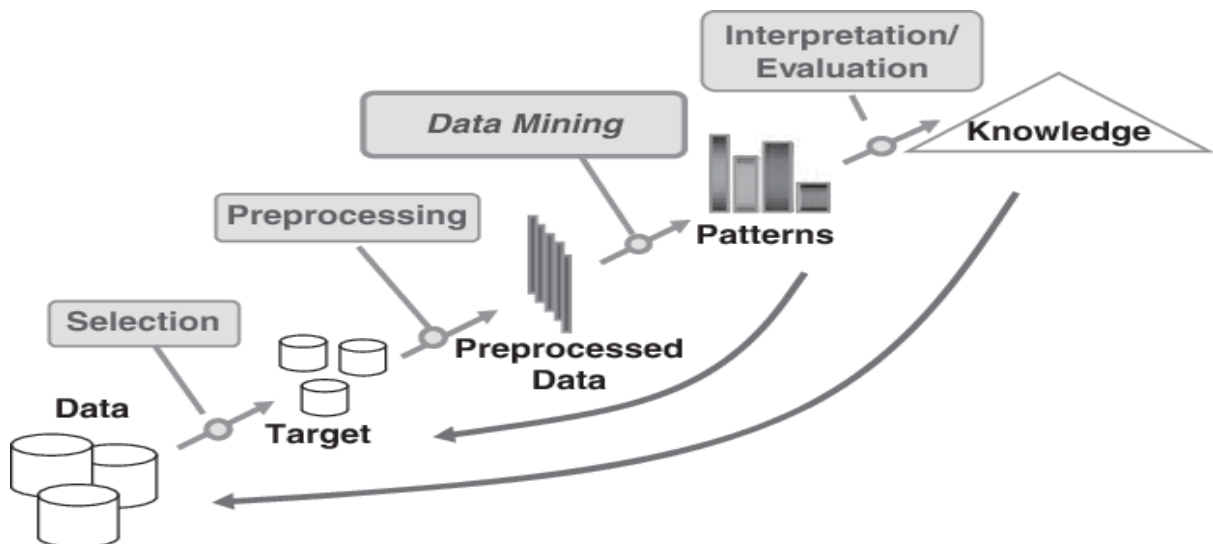
3.3 EXISTINGSYSTEM

A Wireless sensor network (WSN)-based novel framework based on data collection and transmission is proposed to monitor air quality in current systems. The characteristics of the environment to be monitored are temperature, humidity, CO volume, CO₂ volume, and the detection of any gas leakage. The values of these parameters are relayed to a base station, which uses Zigbee Pro to monitor them (S-2). Temperature and air pressure readings are also transmitted through Bluetooth,

allowing anyone within range of the system to confirm them on their own. Temperature and humidity values are also communicated through Bluetooth, allowing anyone within range of the equipment to confirm them. A text message appears when the volume of data exceeds a predetermined safe limit defined for a certain application.

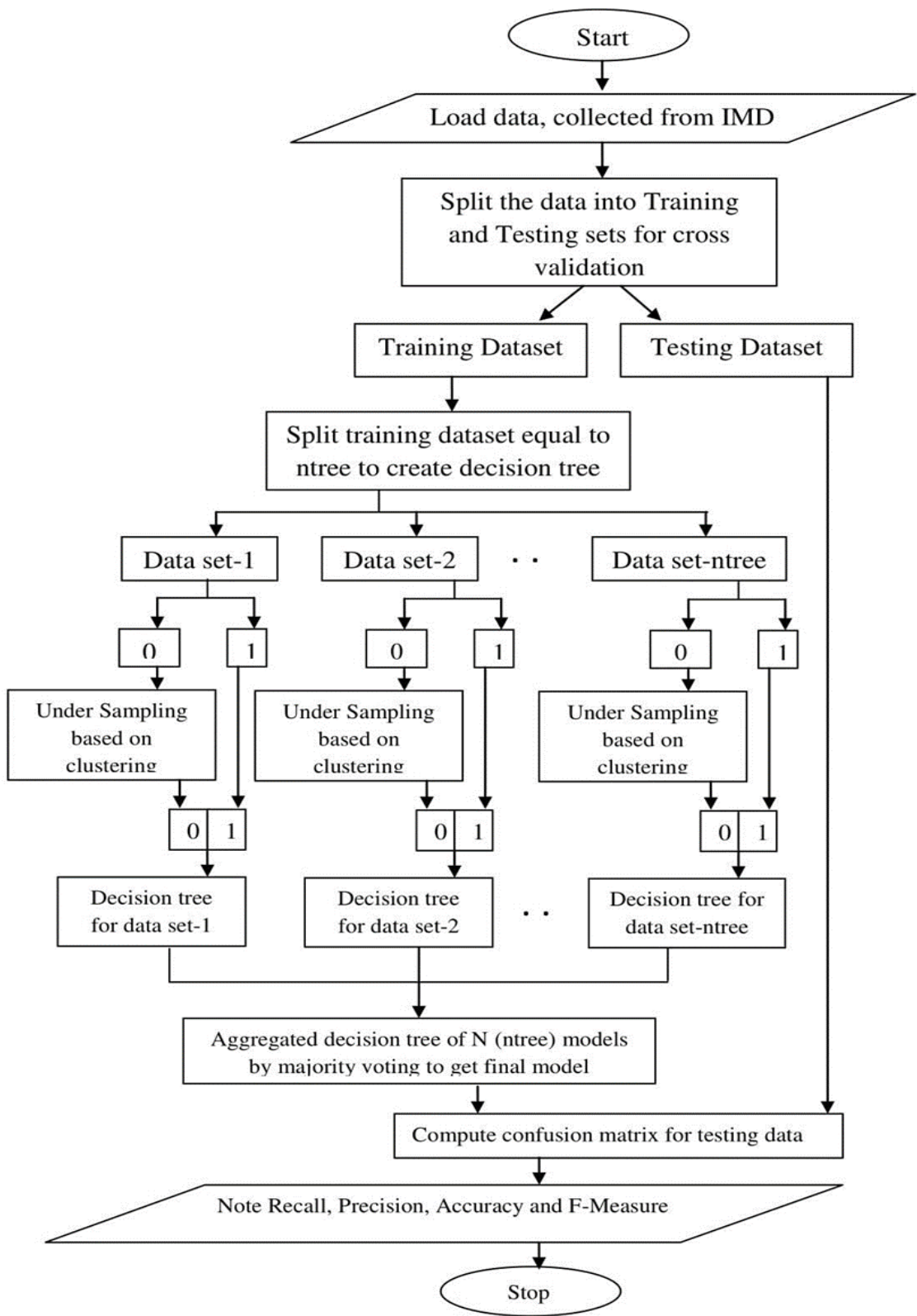
3.4 PROPOSEDSYSTEM

The proposed model can be used to forecast future crop models based on past year's weather data. As a result, farmers can utilize weather-related data to forecast impending crop models and take appropriate safeguards, or they can completely abandon a particular crop. As a result, the suggested crop production model may be broken down into two stages: data collecting and future crop prediction. A variety of weather-related data for several Indian states is obtained during the data collection process. Because the suggested crop production model is being evaluated on cereals and pulses, historical crop data for crops under consideration is being gathered as well. Finally, during the stage of prediction, the XGBOOST with AI classifier is used to project future crop production. A text message is sent to the addressee. The GSM module informs the base station when the volume of the base station exceeds a certain safe limit set for a given application.



3.1 The diagrammatic representation of the methodology

3.5 FLOW CHART



3.2FlowChart

3.6 DATA COLLECTION

In order to improve forecast precision, data collecting is essential. State-level monthly actual average temperature, minimum temperature, and air pressure data from various regions, such as different states in India, as well as data compiled from India's weather data, are among the weather-related data acquired at this stage. Surveillance Center These statistics are being used to forecast future crop yield. Kaggle[19] .

3.6.1 ATTRIBUTES OF THE DATASET

India's Weather Dataset has the following attributes:

- Temperature data—Temperature values from past years have been obtained as a reference.
- Data on air pressure—Air pressure plays an important role in weather forecasting and crop choices.
- Rainfall data - Previous year's rainfall data has been collected in millimeters for comparison.
- States—The names of the states from which temperature and wind pressure data are gathered are supplied in India.
- Dates when data gathered—They are the dates when the information was gathered.
- Longitude and Latitude-The longitude and latitude of the states are listed here.

3.7 PRE-PROCESS THE DATA

Data preparation is the process of converting raw data into an understandable format. Because we can't work with raw data, this is a critical stage in the data mining process, this is an important stage in the data mining process. because we can't operate with raw data. Before using machine learning or data mining tools, be sure the data is of

good quality. There are NAN values in this data, and some of the items are duplicated. As a result, we'll get rid of that at this moment. For the n th year, enter data. As an output, a DNN that has been trained to adjust Data for $(n+1)$ th year. The data from the n th year is used as input. The purpose is to use data from $(n+1)$ th year. Analyze the data.

Data is gathered in various formats from multiple data sources during this procedure. Following preprocessing, these data are turned into the needed structure, and Python techniques are used to uncover hidden patterns and relationships between parameters, resulting in useful information.

3.8 ANALYSE THE DATA

Python models analyse data and produce useful information in the form of a summary report or format. Because feature selection is such a crucial task in developing a decent prediction model, another Python technique to selecting key parameters in a given dataset is feature selection or parameter selection. It improves the efficiency of training and improving a classifier by reducing the size of the efficient training set. Furthermore, by reducing noisy features from datasets, feature selection frequently improves classification accuracy. Classification is a data analysis technique for separating relevant data classes and categories.

The GWO algorithm provides findings based on an arbitrary population with the same number of weights as the number of weights necessary to exhaust all DNN weight possibilities. During each iteration, 10 solutions will be generated at random and compared to the previous best solution to quickly select the best result (weight matrix). When an ideal solution is discovered that outperforms the others, it is selected and saved. Grey wolves are recognized as Peak Predators after effectively encapsulating a Canidae's contribution at the fortitude's feeding chain, precursors and supplying their area.

To examine the congruence between scientific weather forecasting and ethno-meteorology, we analyzed farmers and weather scientists' views of the efficacy of two types of information. First, we investigated how farmers thought about the nature of both local and Western weather forecasting expertise, as well as how accurate are two sets of data are at predicting weather conditions. Farmers' attitudes toward these

knowledge sources will influence their readiness to accept and use meteorological data. Finally, future crop production is forecasted using an adaptive deep neural network classifier in the prediction stage. In the following sections, the steps of the suggested crop production model will be explored in depth. Furthermore, the structure of the supplied crop production model. . Weather forecasts are made by collecting data on the current state of the atmosphere in a specific location and then using weather to predict how the atmosphere will change. Individual input is still required to select the best predictive model for forecasting. Farms are a key consumer of private weather forecasting organizations, and the benefits of better weather forecasting for agriculture are evident. The optimal time to plant, fertilize, irrigate, and harvesting crops is determined by the weather. Accurate weather data for every region of the farm can help farmers increase their productivity. Weather forecasting is useful not just for growing crops, but also for exporting them promptly. Many rural roads in the globe are dirt, and farmers must know when they are safe to use them.

We use data from a specific location to estimate future weather conditions, assisting farmers in selecting the appropriate crops and irrigation methods based on changing weather circumstances. There are several methods for forecasting the weather, ranging from glancing up at the sky, which was used in ancient times, to complex computational models. In this situation, we use it by comparing weather patterns and predicting which crops will thrive in that environment we jumbled the crops and advised the best one to be planted sown based on the user's choices. Deep learning are a type where machine learning makes use of multi-layer neural networks (NNs). The study's principal deep learning technique was the constitutional neural network (CNN). In applications that need a large amount of data, such as picture recognition, CNNs are one of the most often utilized algorithms for showing complex operations and performing design recognition.

3.9 PREDICTION OF THE WEATHER CONDITION

This is the last stage, during which we forecast weather conditions that are suitable for crop selection and irrigation style selection, among other things. In the prediction stage, an adaptive DNN classifier is used to forecast future crop yield. In the following sections, the steps of the suggested crop production model will be explored in depth. Furthermore, the structure of the supplied Crop Production Model. Weather can also be used to determine the optimal times for planting, fertilizing, spraying, irrigating, and

harvesting crops. Accurate weather data for every component of a farmer's operation can help them increase output of the farm. Forecasting the weather is helpful not just for growing crops, but also for quickly exporting them.

The proposed model is provided for predicting crop models for the future based on weather data from prior years. As a result, farmers can utilize weather-related data to foresee impending crop models and take all required safeguards, or they can stop cultivating any given crop. As a result, the model of crop production proposed data collection and crop prediction in the future can be divided into two parts. Allow R_m to represent entering data and 1 Mm 'C' to indicate data leaving the system. For each set of n year data collection, an input R_m is weather-related data, such as Monthly Actual Average Rainfall (mm) by District, temperature, and relative humidity data.

The summed-up model of the neural system can be stated as the total system output and hidden layer yield. In XGBOOST with AI classifier, individual component sources of information are bolstered by loads, which have a core hidden layer that is increasingly covered. Furthermore, a different arrangement of loads repeats the previously shrouded component yields in the second concealed layer, and so on.

Weather is a common natural occurrence that has a significant daily impact on a large percentage of the global human population; in other words, weather events are the most commonly encountered natural occurrences that have a significant daily impact on a large percentage of the world's man or woman population. There are numerous factors that influence the forecasting of weather events in a certain region, and it is impossible to predict weather occurrences precisely. Changing the values of these parameters has a big impact on the weather. Geological conditions also have a significant impact on these values.

As a result, scientists, researchers, and other weather forecasters face a challenging task in predicting accurate weather events for a certain time and location. The topic of weather event forecasting has drawn numerous experts from various study societies because to its direct repercussions on human existence around the world.

3.10 HARDWARE REQUIREMENTS

- PROCESSOR: >Pentium IV 2.4GHz
- SYSTEM TYPE: 32bit / 64 bit
- RAM: >2GB
- OS: WINDOWS 7/8/8.1/10

3.11 SOFTWARE REQUIREMENTS

- HDD: >90GB
- TOOL: anaconda navigator
- TOOL BOX: Machine learning tool box

3.11.1 Anaconda navigator

Anaconda Navigator is a desktop graphical user interface that comes with the Anaconda distribution and allows us to run programs and manage anaconda packages, environments, and channels without having to use command-line commands. Packages can be found on Anaconda.org or in a local Anaconda Repository using Navigator. It's compatible with Windows, Mac OS X, and Linux. Many scientific packages rely on certain versions of other programs to run. Data scientists frequently utilize various versions of many software and isolate these versions using distinct environments. Anaconda is a package and environment manager that can be run from the command line. This assists data scientists in ensuring that each version of each package has all of the dependencies it needs and functions properly. Navigator is a point-and-click interface for working with packages and environments that eliminates the need to type anaconda instructions into a terminal window. We may use it to search packages, install them in an environment, execute them, and update them all from within the navigator. Jupyter Notebooks can be used in the same way. Jupyter Notebooks are a popular system that allows us to integrate our code, descriptive text, output, graphics, and interactive interfaces into a single notebook file that we can edit, view, and use in a web browser. Anaconda is an open-source software package that includes Jupyter, spyder, and other tools for large-scale data processing, data analytics, and scientific computing. R and Python are supported by Anaconda. Python is implemented using Spyder. In spyder, we can use OpenCV for python. The anaconda package management system keeps track of package versions. Anaconda must be installed before it can be used. Anaconda is a Python and R programming language distribution aimed at making package management and deployment easier in scientific computing like data science, machine learning applications, large-scale data processing, and predictive analytics. For Windows, Linux, and MacOS, the distribution offers data-science packages. Anaconda Distribution or Anaconda Individual Edition are two Anaconda, Inc. products, whereas Anaconda Team Edition and Anaconda Enterprise Edition, both of which are not free,

are two more Anaconda, Inc. Products. Anaconda's package management system keeps track of package versions. This package manager was spun off as a distinct open-source package because it turned out to be valuable in and of itself, not just for Python. Miniconda is a minimal, bootstrapped version of Anaconda that only includes Conda, Python, their dependencies, and a few other packages. Over 250 packages are installed by default in the Anaconda distribution, and over 7,500 more open-source packages, as well as the Conda package and virtual environment manager, can be downloaded from PyPI. As a graphical alternative to the command-line interface, Anaconda Navigator is included. The main difference between Conda and pip is how to package dependencies are maintained, which is a key difficulty for Python data science and the basis for Conda's existence. Conda examines the current environment, including everything installed, and, along with any version limitations specified, determines how to install a compatible set of dependencies, and issues a warning if this is not possible. Using the Conda install command, users can install open-source packages individually from the Anaconda repository, Anaconda Cloud, or their own private repository or mirror. Anaconda, Inc. compiles and builds the packages in the Anaconda repository and distributes binaries for Windows 32/64 bit, Linux 64 bit, and MacOS 64 bit. Custom packages can be created using the Conda build command and shared with others via Anaconda Cloud, PyPI, or other repositories. Anaconda2 comes with Python 2.7 by default, while Anaconda3 comes with Python 3.7 by default. However, any Python version supplied with anaconda can be used to construct new environments.

3.11.2 Python

Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991. Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.

Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including structured (particularly, procedural), object-oriented, and functional programming. Python is often described as a "batteries included" language due to its comprehensive standard library. Python interpreters are available for many operating systems. A global community of programmers develops and maintains

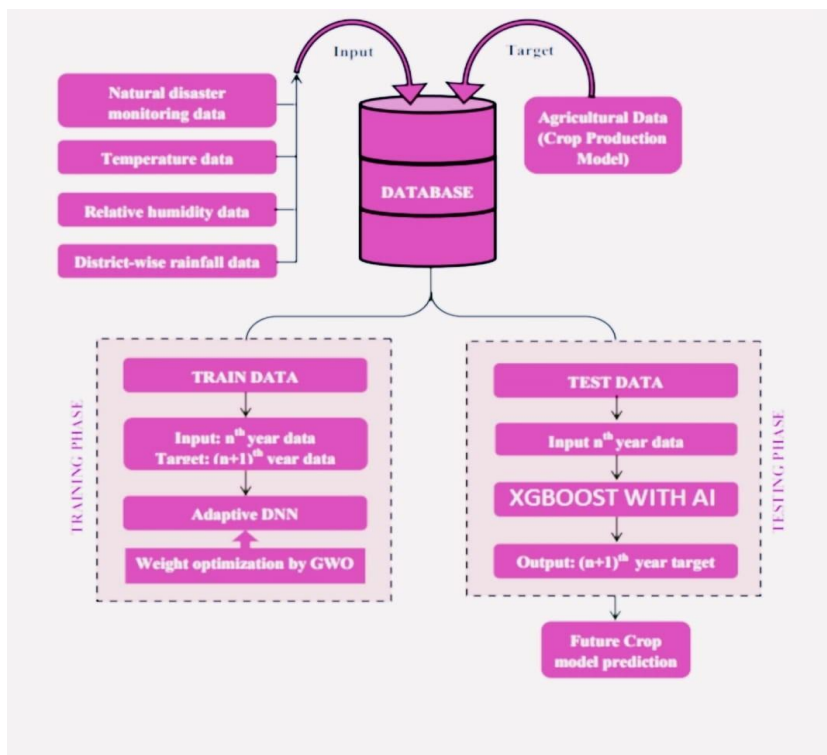
CPython, an open-source reference implementation. A non-profit organization, the Python Software Foundation, manages and directs resources for Python and CPython development. Python is meant to be an easily readable language. Its formatting is visually uncluttered, and it often uses English keywords where other languages use punctuation. Unlike many other languages, it does not use curly brackets to delimit blocks, and semicolons after statements are optional. It has fewer syntactic exceptions and special cases than C or Pascal.

CHAPTER-4

ARCHITECTURE DIAGRAM ANDALGORITHMSUSED

4.1 ARCHITECTURE DIAGRAM

Due to present global climate change, weather forecasting accuracy is extremely difficult to predict. The results of utilizing only one technique were not as exact as they may have been. In this study, we used a multi-model/technique concept to determine accurate rainfall. It will be created to combine two or more models/techniques. ANNs, k-NN classifiers, Fuzzy Neuro Networks, Rough Set Theory, Support Vector Regression (SVR), XGBOOST, Adaboost, BP Neural Network, statistical models, and machine learning models are examples of these models/ methods.



4.1 ARCHITECTURE DIAGRAM

4.2 ALGORITHM

XGBoost Features

The library is laser focused on computational speed and model performance, as such there are few frills. Nevertheless, it does offer a number of advanced features. The implementation of the algorithm was engineered for efficiency of compute time and memory resources. A design goal was to make the best use of available resources to train the model. Some key algorithm implementation features include:

- **Sparse Aware** implementation with automatic handling of missing data values.
- **Block Structure** to support the parallelization of tree construction.
- **Continued Training** so that you can further boost an already fitted model on new data. XGBoost is free open source software available for use under the permissive Apache-2 license.

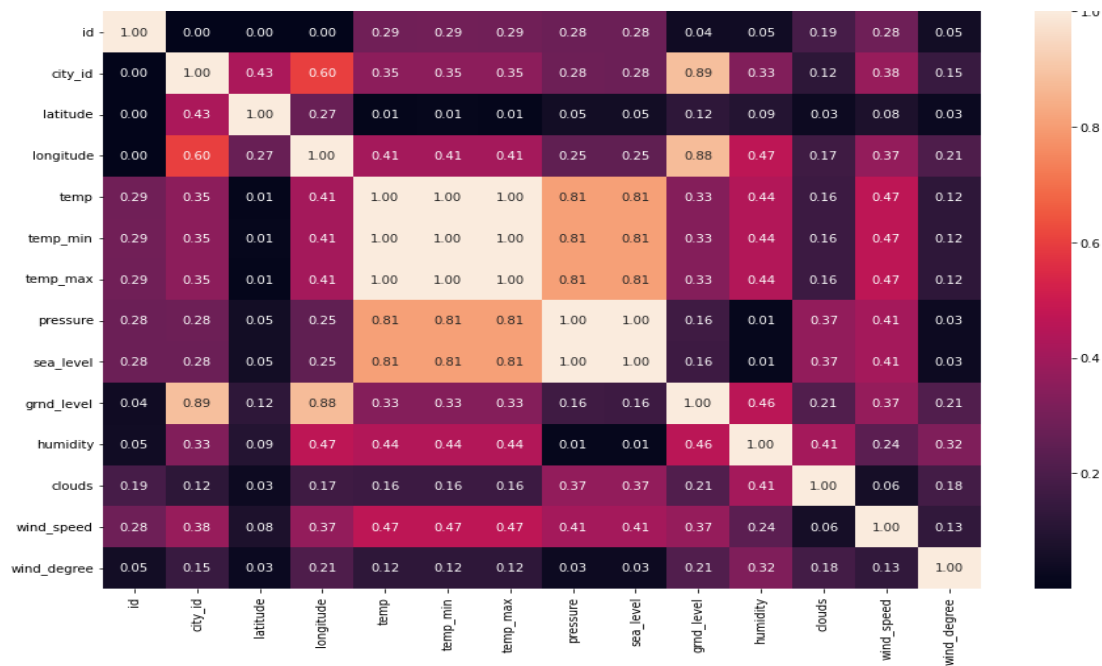
The list of benefits and attributes of XGBoost is extensive, and includes the following:

- A large and growing list of data scientists globally that are actively contributing to XGBoost open source development.
- Usage on a wide range of applications, including solving problems in regression, classification, ranking, and user-defined prediction challenges.
- A library that's highly portable and currently runs on OS X, Windows, and Linux platforms.
- Cloud integration that supports AWS, Azure, Yarn clusters, and other ecosystems.
- Active production use in multiple organizations across various vertical market areas.
- A library that was built from the ground up to be efficient, flexible, and portable.

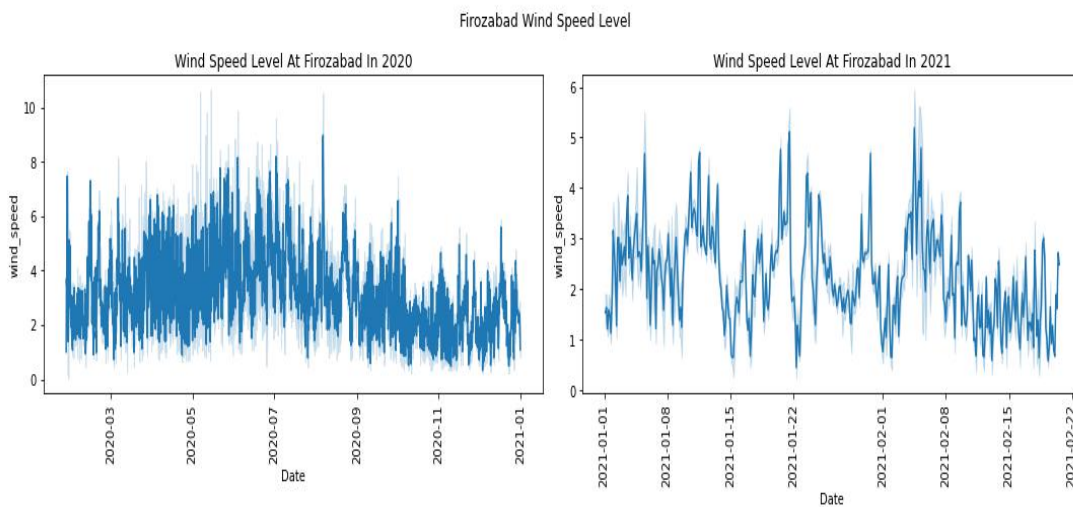
CHAPTER 5

RESULT AND DISCUSSION

The project's output will be (n+1) year weather forecast. Based on climatic changes, an adaptive deep neural network architecture is developed for weather prediction. The technique is written in Python, and the testing is carried out on a system with 4 GB of RAM and an Intel I-5 processor. The weather history dataset, which contains temperature, wind speed, humidity, and other data, is provided as input. Agriculture reaps the benefits of sophisticated climate forecasting, making farms a primary client of personal forecasting services.

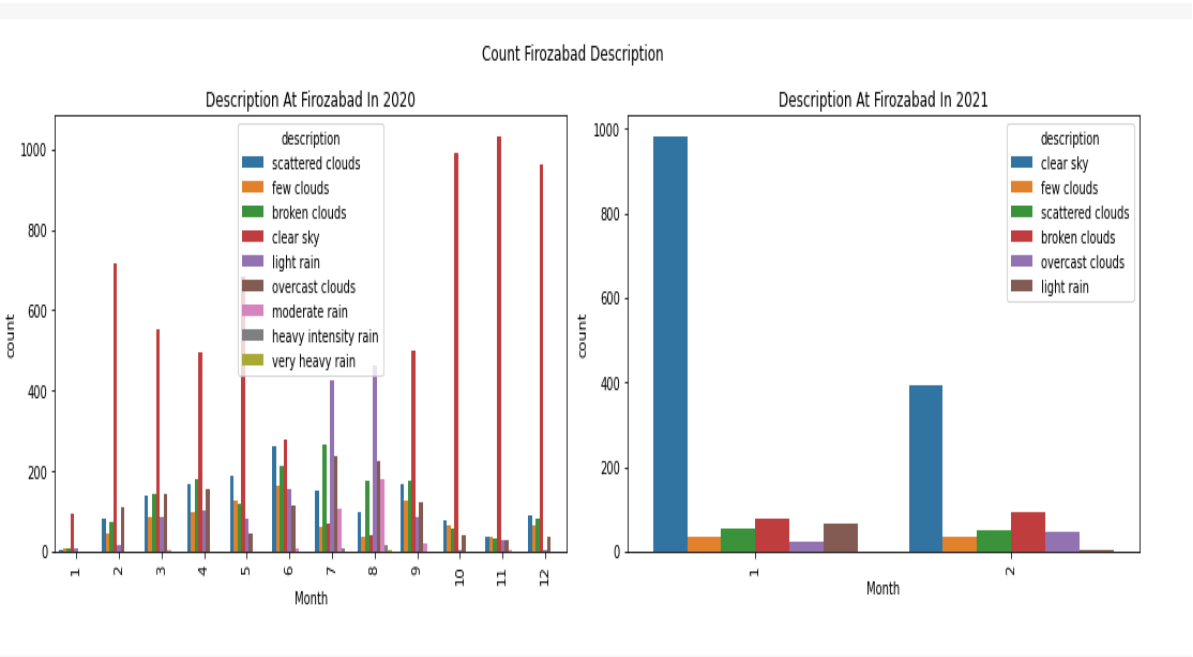


5.1 correlation matrix

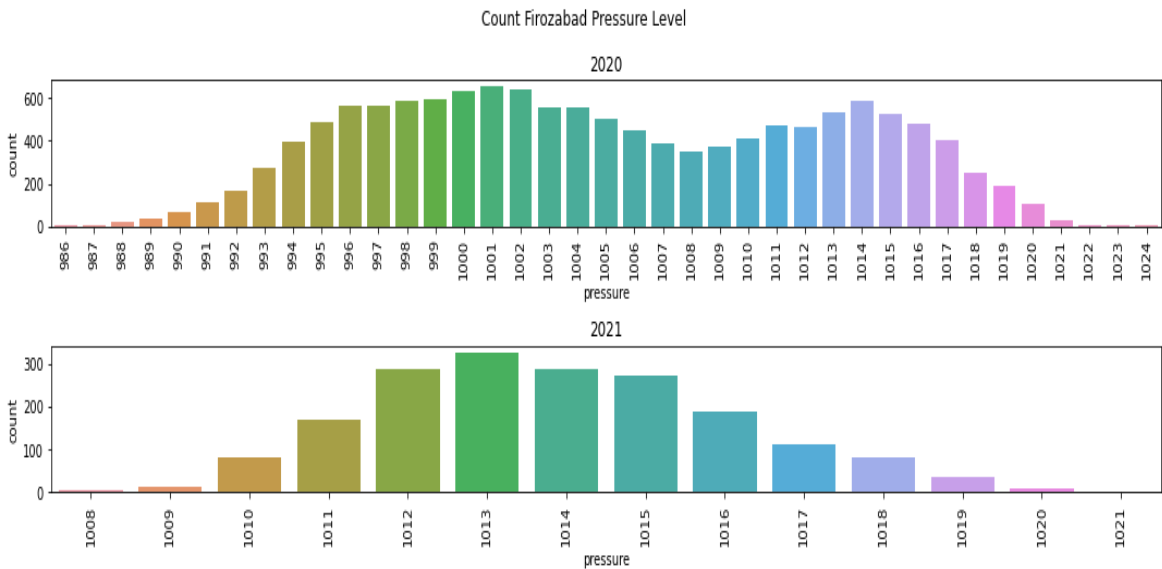


5.2 windspeed level

The weather determines the optimal time to sow, fertilize, water, and harvest plants. Farmers can boost their output by obtaining correct climate data for each of their fields' regions. Weather forecasting not only aids in the development of plants, but also in their on-the-spot delivery.



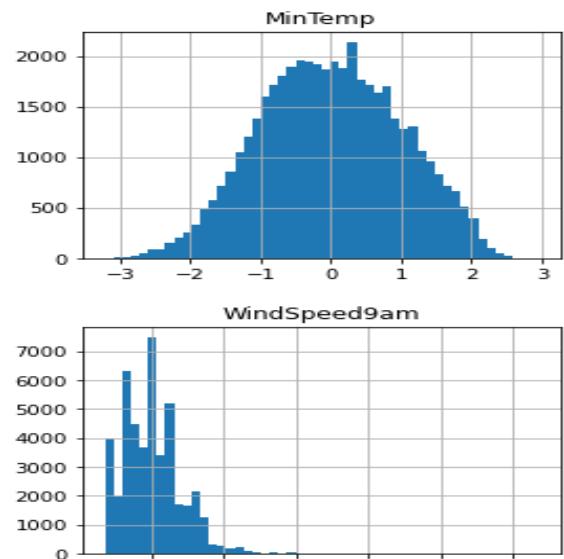
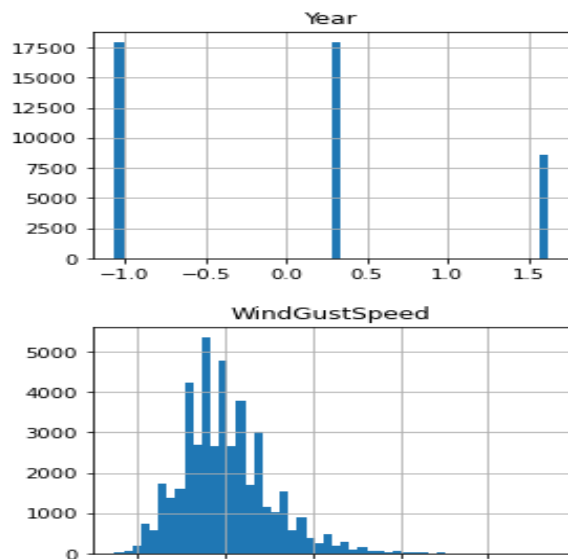
5.3 description at Firozabad



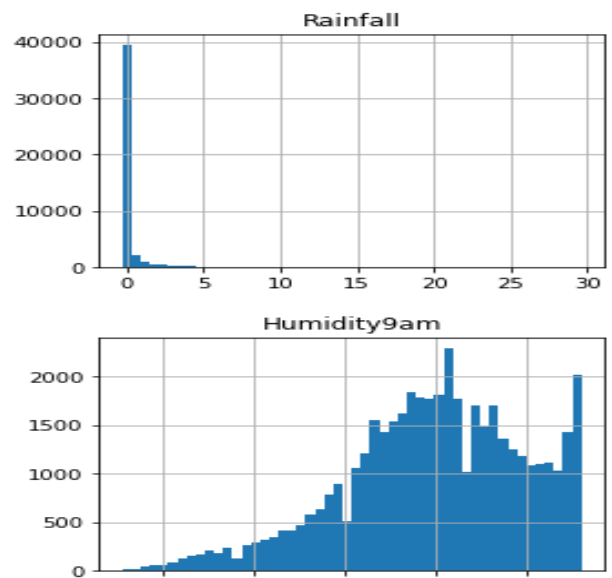
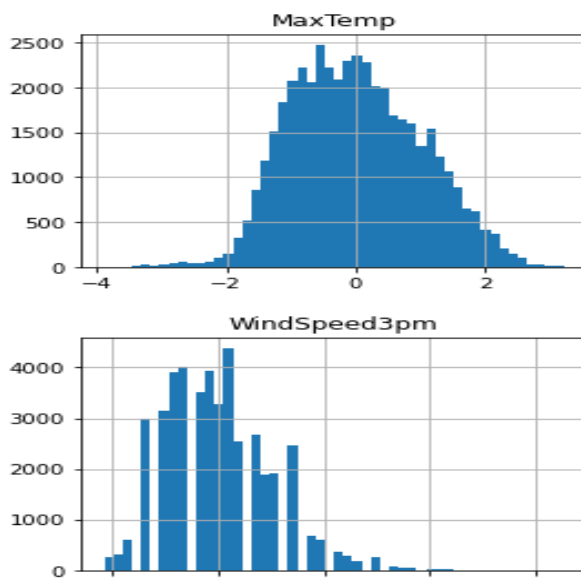
5.4 Pressure level

Many of the sector's rural roads are dirt, and farmers must know when they are dry enough to apply fertilizer. Modeling software such as MATLAB, Python, and R. The utilisation of weather data is required for this project. The metrological department will provide 25 years of weather data for testing purposes. 15 years of data will be used to train the model, with the remaining 10 years of data being used to test its performance.

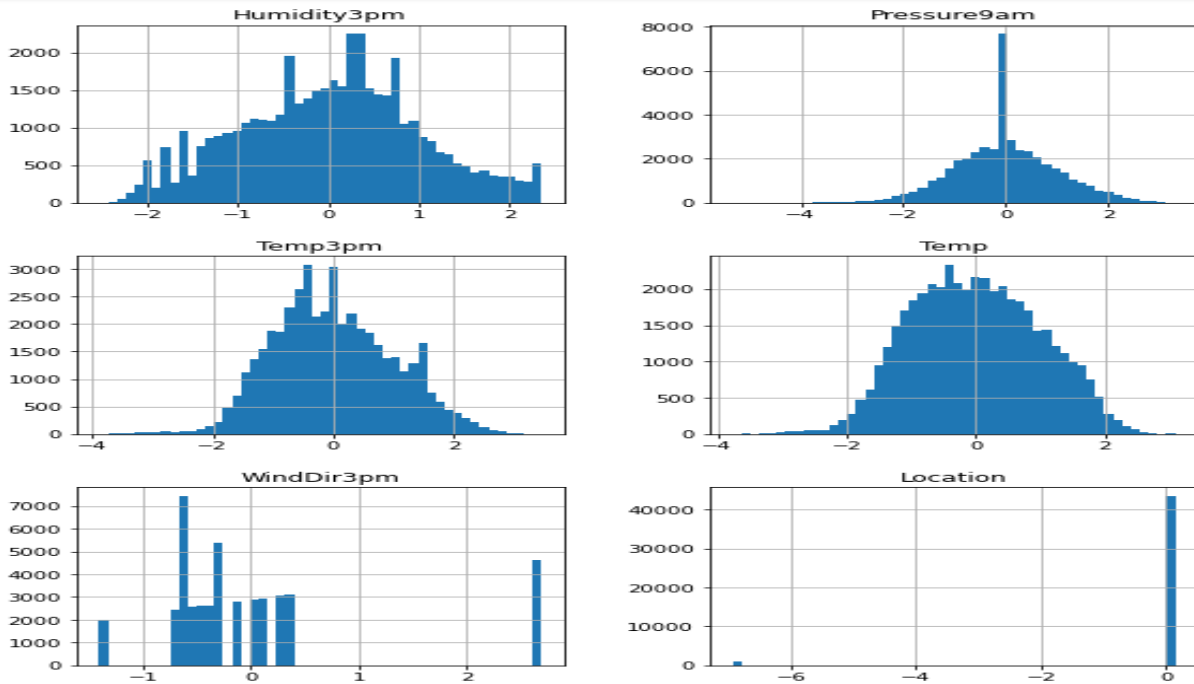
Environmental factors have an impact on rainfall prediction accuracy. During data analysis, try to find more effective parameters that are accountable for rainfall. The parameters will be relative humidity, dry bulb temperature, dew point temperature, daily weather amount, wind speed, mean sea-level pressure, Mean value, variation, high echo ratio, and Geopotential Height. Temperatures in the air, vertical velocity, wind directions, and vertical velocity are all factors to consider.



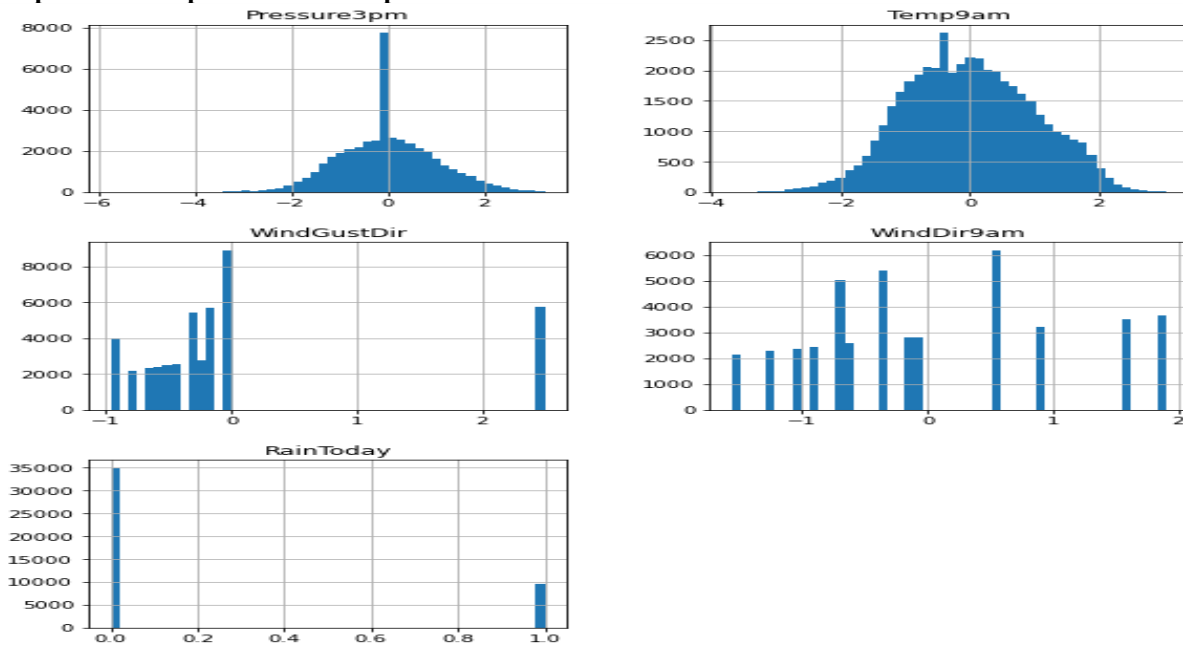
5.5 prediction of windspeed and wind direction



5.6 prediction of max temperature, rainfall and humidity



5.7 prediction of pressure and temperature at 3am



5.8 prediction of pressure and temperature at 9am

Crop yield is heavily influenced by weather quantity. In compared to the other seasons, the Kharif season is more weather-dependent. During the Rabi and Zaid seasons, farmers used irrigation systems and were not fully on on the weather, even if favourable weather has a significant impact on crop yield. Weather volume, temperature, and the number of days of weather in that particular monsoon season affect most agricultural crops, particularly those grown in the kharif season.

CHAPTER–6

CONCLUSIONANDFUTUREENHANCEMENT

6.1 CONCLUSION

This study sheds light on one of the most important issues confronting Indian farmers: deciding which crop to plant based on weather forecasts. Governments and corporations spend billions of dollars each year on weather forecasting for good reason. Weather has a direct and indirect impact on every sector of the economy. The amount of weather-associated data available will continue to rise up, recent developments in machine learning are allowing government agencies and businesses to better utilize it all. Improved and hyper-localized weather forecasting allows a variety of organizations to save money a minor reduction in field irrigation, a slightly more efficient flying path for an airline, a few hours faster in fixing an outage, and so on.

The demand for weather and climate forecast data to support critical decision-making has hyped up significantly over the last decade and is expected to increase further in the coming years. Weather forecasting advancements will provide enterprises with new relevant data by showing new connections and providing them with more time to capitalize on them

These breakthroughs are increasingly involving the private sector. At the same time, recurrent flaws in the primary observation system have impeded advancement. For crop model prediction, we developed a new architecture called the Adaptive Deep Neural Network. Rice, wheat, maize, ragi, and other grains and pulses are among the crops now being researched.

The suggested future crop prediction model using ADNN is compared to other current strategies using standard DNN and Modified ANN in terms of several performance analytics parameters (Social Spider Optimization based ANN). The proposed ADNN-based prediction model exhibits consistent improvement in all five districts when compared to existing approaches, confirming the utility of our proposed future crop prediction model.

6.2 FUTURE ENHANCEMENT

In future even minor advances in weather forecasting will provide businesses with new usable data by uncovering new correlations and providing them with more time to capitalize on them. The demand for weather and climate forecast information in support of crucial decision-making has increased dramatically over the last decade and will continue to do so in the next years. Supercomputers, satellite and remote sensing technology, and smart mobile devices have transformed the development and delivery of these services. The business sector is increasingly contributing to these advances. At the same time, persistent flaws in the core observation mechanism have impeded development.

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APPENDIX

A.SAMPLE CODE

```
import os
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")
%matplotlib inline
df = pd.read_csv('../input/indias-weather-data/weather_data.csv')

df.shape

# For practice, I only use data from Uttar Pradesh and then I only choose 5 city
Uttar = df[df['state']=='Uttar Pradesh']
city = ['Firozabad','Hathras','Lalitpur','Kaushambi','Lucknow']
new_df = Uttar.query(f"city_name in {city}").reset_index(drop=True)
new_df.sample(5)
new_df.info()

# Correlation
plt.figure(figsize=(15,10))
sns.heatmap(new_df.corr().abs(), annot=True, fmt='.2f')

# Look Numeric and Categorical Column
numeric_variables = new_df.select_dtypes(include=[np.number])
text_variables = new_df.select_dtypes(exclude=[np.number])
print(f"Numeric Column : {numeric_variables.columns.to_list()}")
print(f"Text Column : {text_variables.columns.to_list()}")
new_df.head()

df_firozabad = new_df[new_df['city_name']=='Firozabad']
df_hathras = new_df[new_df['city_name']=='Hathras']
df_lalitpur = new_df[new_df['city_name']=='Lalitpur']
df_lucknow = new_df[new_df['city_name']=='Lucknow']
df_kaushambi = new_df[new_df['city_name']=='Kaushambi']
for i in df_firozabad.columns:
    print(f"{i} Unique Values : {len(df_firozabad[str(i)].unique())}")

class PlotEDA:
```

```

def __init__(self, df, year=[2020,2021]):
    self.df = df
    self.year = year

def plot_temp(self):
    for e,y in enumerate(self.year):
        plt.suptitle(f'{self.df['city_name'][0]} Temperature Level')
        plt.subplot(1, 2, e+1)
        sns.lineplot(data=self.df[self.df['year']==y], x='dt_txt', y='temp')
        plt.title(f'Temperature Level At {self.df['city_name'][0]} In {y}')
        plt.xlabel('Date')
        plt.xticks(rotation=90)
        plt.tight_layout()

def plot_pressure(self, plot='line'):
    if plot == 'line':
        for e,y in enumerate(self.year):
            plt.suptitle(f'{self.df['city_name'][0]} Pressure Level')
            plt.subplot(1, 2, e+1)
            sns.lineplot(data=self.df[self.df['year']==y], x='dt_txt', y='pressure')
            plt.title(f'Pressure Level At {self.df['city_name'][0]} In {y}')
            plt.xlabel('Date')
            plt.xticks(rotation=90)
            plt.tight_layout()

    elif plot == 'count':
        for e,y in enumerate(self.year):
            plt.suptitle(f'Count {self.df['city_name'][0]} Pressure Level')
            plt.subplot(2, 1, e+1)
            sns.countplot(data=self.df[self.df['year']==y], x='pressure')
            plt.title(f'{y}')
            plt.xticks(rotation=90)
            plt.tight_layout()

```

```

def plot_sealvl(self, plot='line'):
    if plot == 'line':
        for e,y in enumerate(self.year):
            plt.suptitle(f'{self.df['city_name'][0]} Sea Level')
            plt.subplot(1, 2, e+1)
            sns.lineplot(data=self.df[self.df['year']==y], x='dt_txt', y='sea_level')
            plt.title(f'Sea Level At {self.df['city_name'][0]} In {y}')
            plt.xlabel('Date')
            plt.xticks(rotation=90)
            plt.tight_layout()

    elif plot == 'count':
        for e,y in enumerate(self.year):
            plt.suptitle(f'Count {self.df['city_name'][0]} Sea Level')
            plt.subplot(2, 1, e+1)
            sns.countplot(data=self.df[self.df['year']==y], x='sea_level')
            plt.title(f'{y}')
            plt.xticks(rotation=90)
            plt.tight_layout()

def plot_grndlvl(self, plot='line'):
    if plot == 'line':
        for e,y in enumerate(self.year):
            plt.suptitle(f'{self.df['city_name'][0]} Ground Level')
            plt.subplot(1, 2, e+1)
            sns.lineplot(data=self.df[self.df['year']==y], x='dt_txt', y='grnd_level')
            plt.title(f'Sea Level At {self.df['city_name'][0]} In {y}')
            plt.xlabel('Date')
            plt.xticks(rotation=90)
            plt.tight_layout()

    elif plot == 'count':
        for e,y in enumerate(self.year):
            plt.suptitle(f'Count {self.df['city_name'][0]} Ground Level')

```

```

plt.subplot(2, 1, e+1)
sns.countplot(data=self.df[self.df['year']==y], x='grnd_level')
plt.title(f'{y}')
plt.xticks(rotation=90)
plt.tight_layout()

```

```
def plot_main(self):
```

```

    for e,y in enumerate(self.year):
        plt.suptitle(f'{self.df['city_name'][0]} Main')
        plt.subplot(1, 2, e+1)
        sns.countplot(data=self.df[self.df['year']==y], x='month', hue='main')
        plt.title(f'Main At {self.df['city_name'][0]} In {y}')
        plt.xlabel('Month')
        plt.xticks(rotation=90)
        plt.tight_layout()

```

```
def plot_description(self):
```

```

    for e,y in enumerate(self.year):
        plt.suptitle(f'Count {self.df['city_name'][0]} Description')
        plt.subplot(1, 2, e+1)
        sns.countplot(data=self.df[self.df['year']==y], x='month', hue='description')
        plt.title(f'Description At {self.df['city_name'][0]} In {y}')
        plt.xlabel('Month')
        plt.xticks(rotation=90)
        plt.tight_layout()

```

```
def plot_cloud(self):
```

```

    for e,y in enumerate(self.year):
        plt.suptitle(f'{self.df['city_name'][0]} Cloud Level')
        plt.subplot(1, 2, e+1)
        sns.lineplot(data=self.df[self.df['year']==y], x='dt_txt', y='cloud')
        plt.title(f'Cloud Level At {self.df['city_name'][0]} In {y}')
        plt.xlabel('Date')
        plt.xticks(rotation=90)

```

```
plt.tight_layout()
```

```
def plot_windspeed(self):
```

```
    for e,y in enumerate(self.year):
```

```
        plt.suptitle(f'{self.df['city_name'][0]} Wind Speed Level')
```

```
        plt.subplot(1, 2, e+1)
```

```
        sns.lineplot(data=self.df[self.df['year']==y], x='dt_txt', y='wind_speed')
```

```
        plt.title(f'Wind Speed Level At {self.df['city_name'][0]} In {y}')
```

```
        plt.xlabel('Date')
```

```
        plt.xticks(rotation=90)
```

```
        plt.tight_layout()
```

```
def plot_winddegree(self):
```

```
    for e,y in enumerate(self.year):
```

```
        plt.suptitle(f'{self.df['city_name'][0]} Wind Degree Level')
```

```
        plt.subplot(1, 2, e+1)
```

```
        sns.lineplot(data=self.df[self.df['year']==y], x='dt_txt', y='wind_degree')
```

```
        plt.title(f'Wind Degree Level At {self.df['city_name'][0]} In {y}')
```

```
        plt.xlabel('Date')
```

```
        plt.xticks(rotation=90)
```

```
        plt.tight_layout()
```

```
for col in df_num.columns.values:
```

```
    if data[col].isnull().sum() == 0:
```

```
        continue
```

```
    df_num[col] = data.groupby(['Location'])[col].apply(lambda x: x.fillna(x.mean()))
```

```
df_num['WindGustSpeed']=df_num['WindGustSpeed'].fillna(data['WindGustSpeed'].mean())
```

```
df_num['Pressure9am']=df_num['Pressure9am'].fillna(data['Pressure9am'].mean())
```

```
df_num['Pressure3pm']=df_num['Pressure3pm'].fillna(data['Pressure3pm'].mean())
```

```
d={'Yes':1,'No':0}
```

```
df_cat['RainTomorrow']=df_cat['RainTomorrow'].map(d)
```

```
df_cat['RainToday']=df_cat['RainToday'].map(d)
```

```
df_cat2=df_cat[['WindGustDir','WindDir9am','WindDir3pm','Location']]
```

#Replacing Categories value with value counts

```
df_cat2['Location']=df_cat2['Location'].map(df_cat2['Location'].value_counts())
df_cat2['WindGustDir']=df_cat2['WindGustDir'].map(df_cat2['WindGustDir'].value_counts())
df_cat2['WindDir9am']=df_cat2['WindDir9am'].map(df_cat2['WindDir9am'].value_counts())
df_cat2['WindDir3pm']=df_cat2['WindDir3pm'].map(df_cat2['WindDir3pm'].value_counts())
df_n=pd.merge(df_num, df_cat2, left_index=True, right_index=True)
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaler.fit(df_n)
df_scaled = pd.DataFrame(scaler.fit_transform(df_n),columns = df_n.columns)
df_x=pd.merge(df_scaled, df_cat['RainToday'],left_index=True, right_index=True)
df_x.hist(bins=50, figsize=(20, 20))
plt.show()

# Let see the correlation

plt.figure(figsize=(20,10))
heatmap = sns.heatmap(df_x.corr(), vmin=-1, vmax=1, annot=True)
# Temp9am(89%) and Temp3pm(98%) has high correlation with MaxTemp

df_x.drop('Temp9am',axis=1,inplace=True)
df_x.drop('Temp3pm',axis=1,inplace=True)
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(df_x, df_cat['RainTomorrow'], test_size=0.2, random_state=50)
#As we can see we are dealing with big imbalance dataset, We need to perform oversampling

df_cat['RainTomorrow'].value_counts().plot(kind='barh')
# Oversampled

from imblearn.over_sampling import SMOTE
sm = SMOTE(random_state = 37)
X_train_res, y_train_res = sm.fit_resample(X_train, y_train)
from collections import Counter
```

```

print("Before {}".format(Counter(y_train)))
print("After {}".format(Counter(y_train_res)))
# XGBoost

from sklearn import datasets, linear_model, metrics
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score
from xgboost import XGBClassifier

model = XGBClassifier(max_depth=10, random_state = 37)
model.fit(X_train_res, y_train_res)
model.score(X_train_res, y_train_res)

y_pred = model.predict(X_test)
from fbprophet import Prophet
m = Prophet()
df_for=data[['Date', 'Rainfall']]
df_for['Date']=pd.to_datetime(df_for['Date'])
df_for.rename(columns = {'Date':'ds'}, inplace = True)
df_for.rename(columns = {'Rainfall':'y'}, inplace = True)
m.fit(df_for)
from fbprophet.plot import add_changepoints_to_plot
fig = m.plot(forecast)
a = add_changepoints_to_plot(fig.gca(), m, forecast)
%matplotlib inline
plt.rcParams['figure.figsize'] = [14, 8]
df.maxhumidity_1.hist()
plt.title('Distribution of maxhumidity_1')
plt.xlabel('maxhumidity_1')
plt.show()
df.minpressurem_1.hist()
plt.title('Distribution of minpressurem_1')
plt.xlabel('minpressurem_1')
plt.show()

```

```
# Print precision, F1 score and accuracy of our model
print('Precision: ', precision)
print('F1 Score: ', f1_score)
print('Accuracy: ', accuracy)
```

B.SCREEN SHOTS

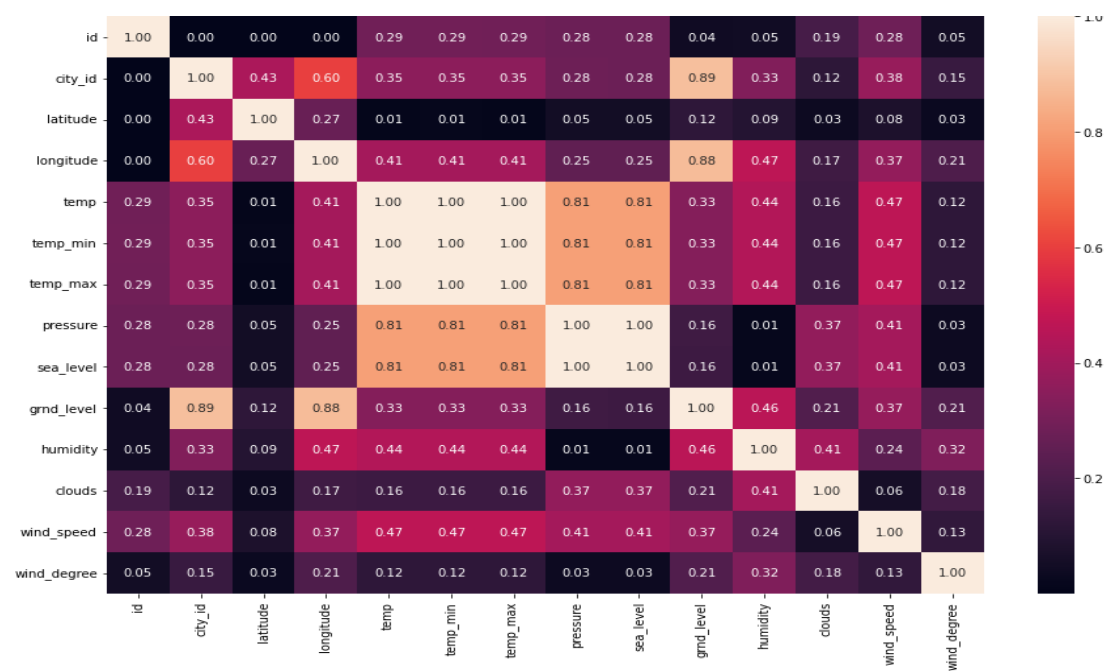


Figure.1 correlation matrix

Firozabad Wind Speed Level

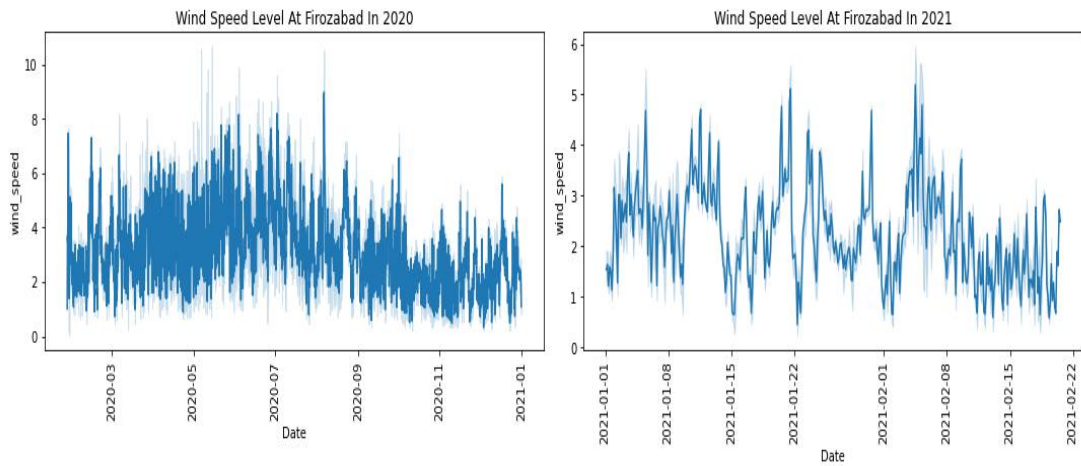


Figure.2 windspeed level

Count Firozabad Description

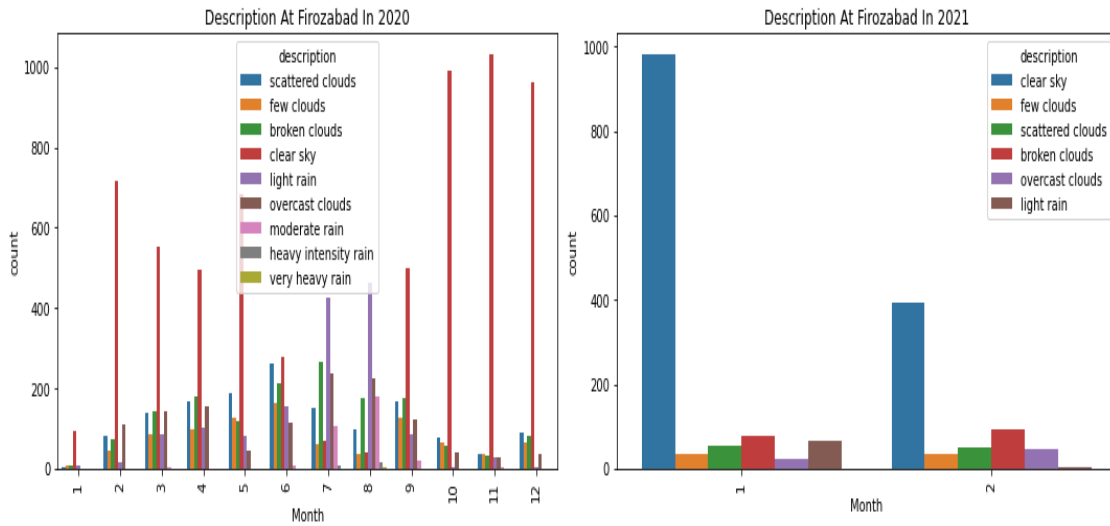


Figure.3 description at Firozabad

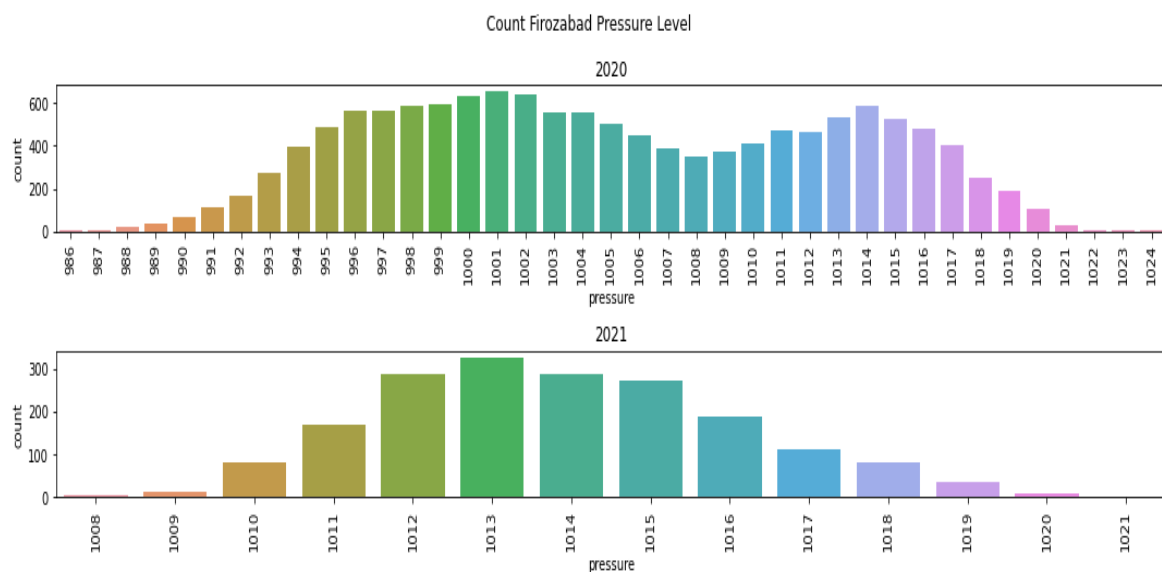


Figure.4 Pressure level

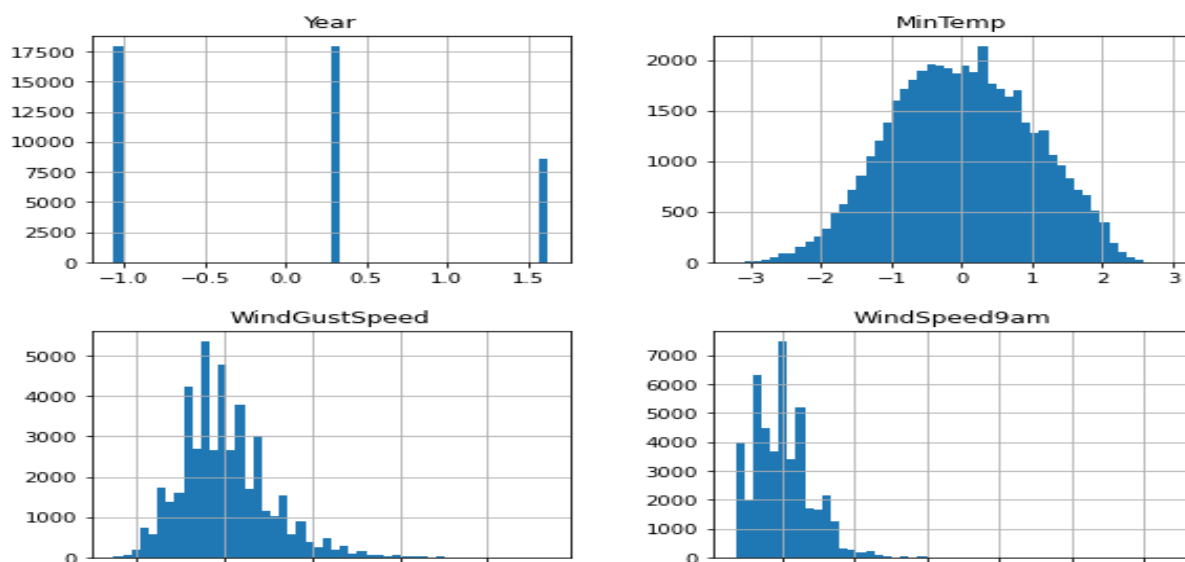


Figure.5 prediction of windspeed and wind direction

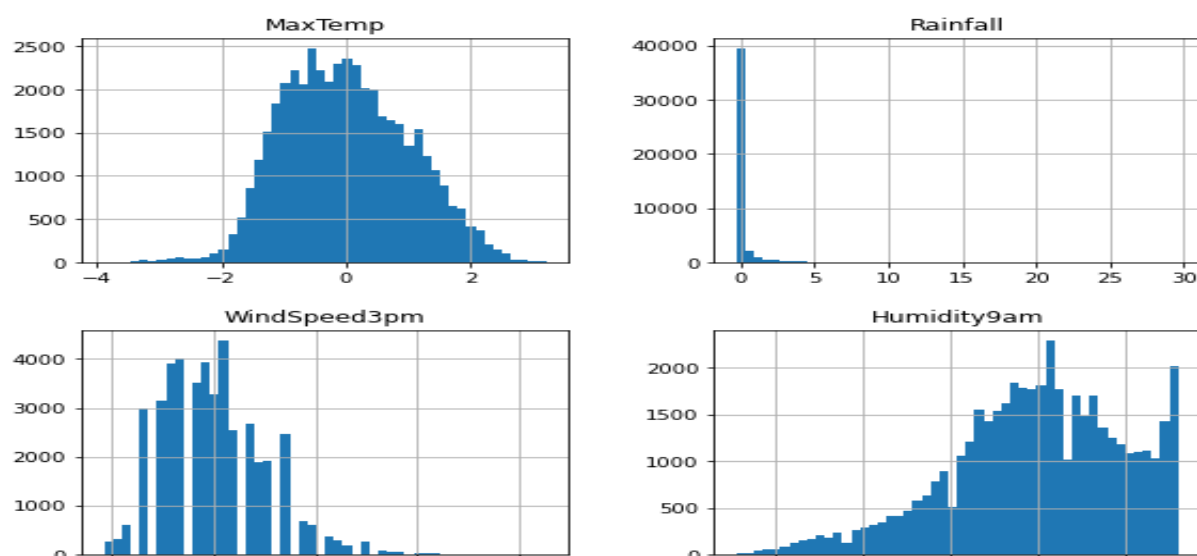


Figure.6 prediction of max temperature, rainfall and humidity

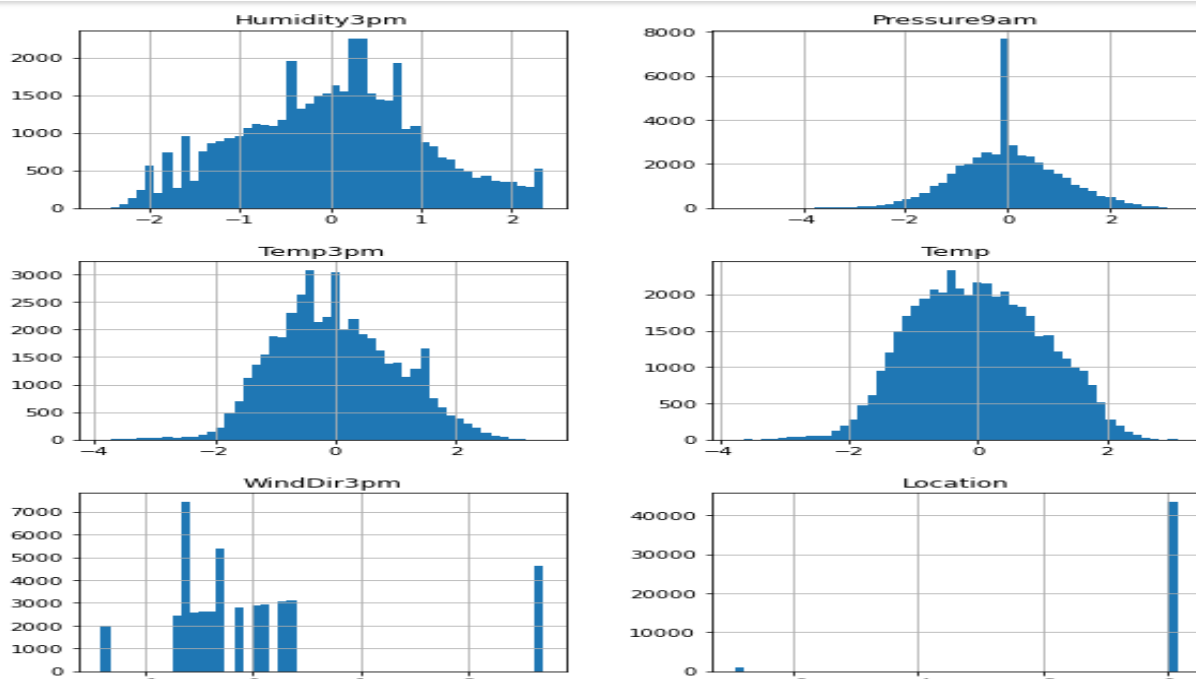


Figure.7 prediction of pressure and temperature at 3am

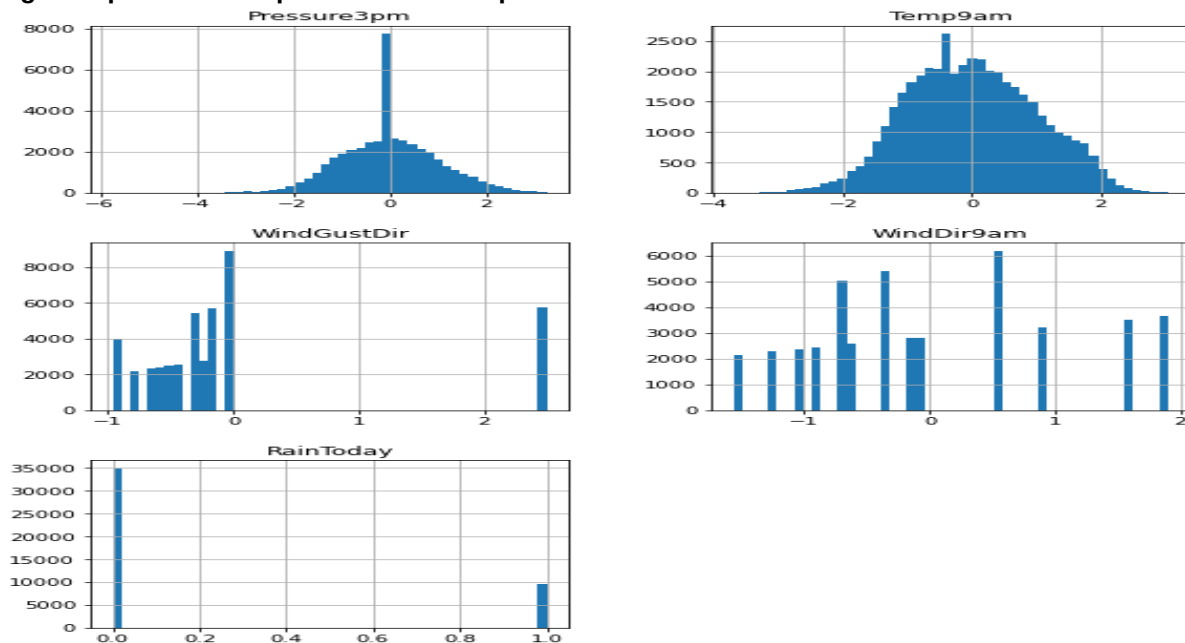


Figure.8 prediction of pressure and temperature at 3am

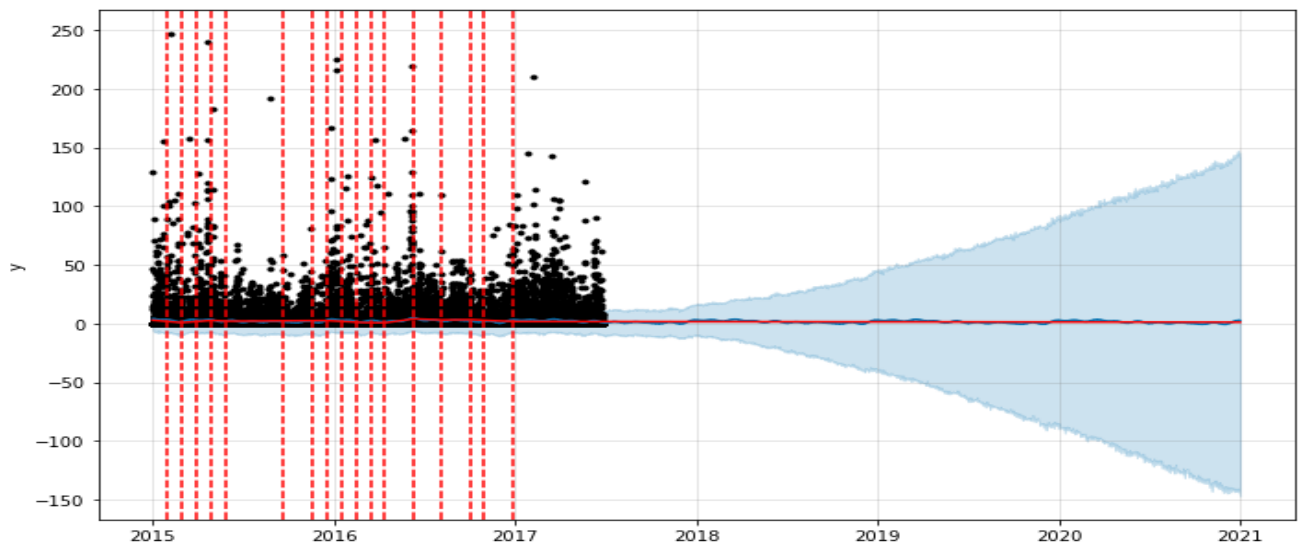


Figure.9 analysis of weather after 2015 till 2021

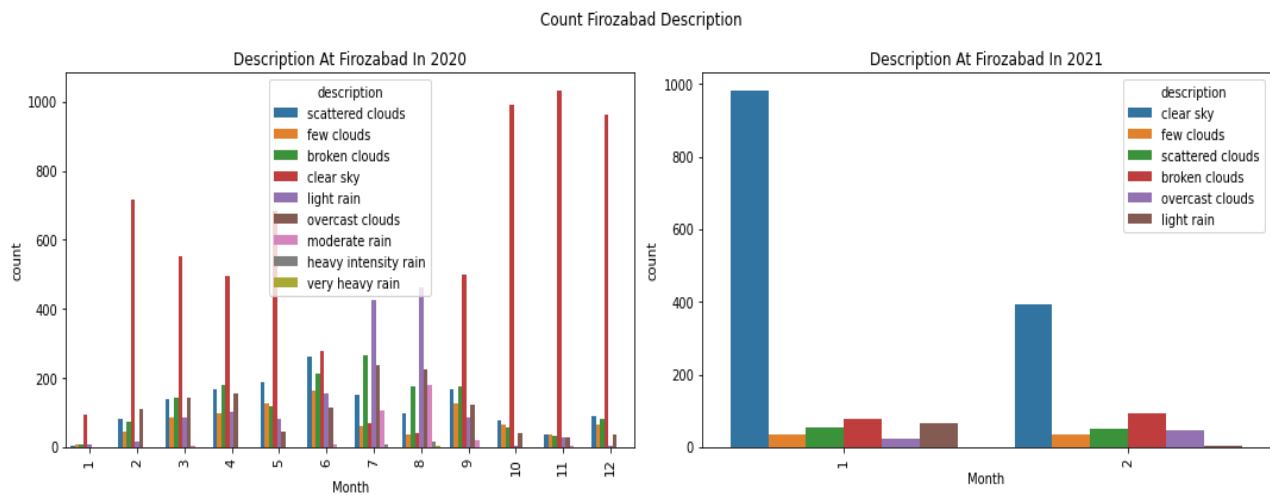


Figure .10 description of climate in firozbad

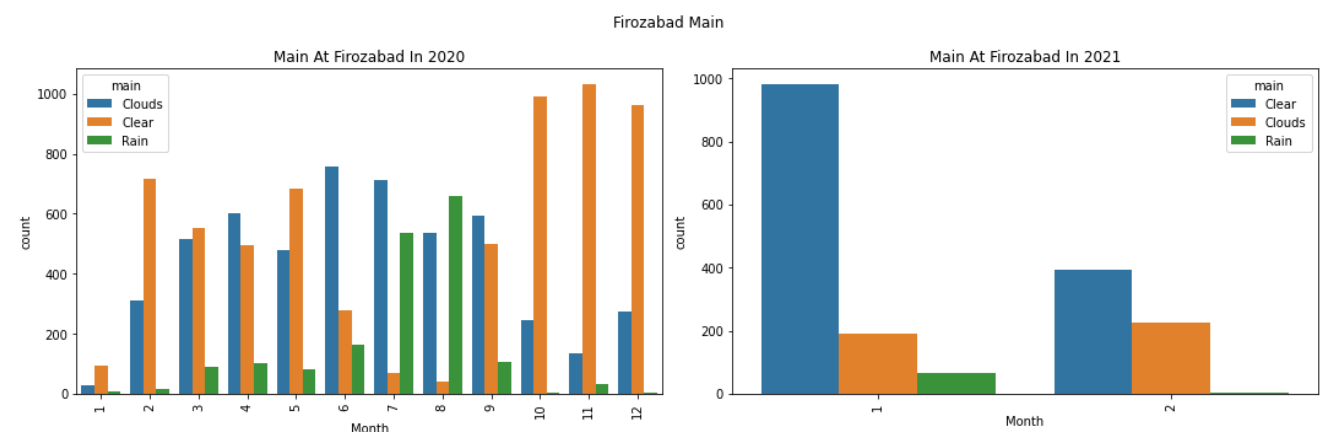
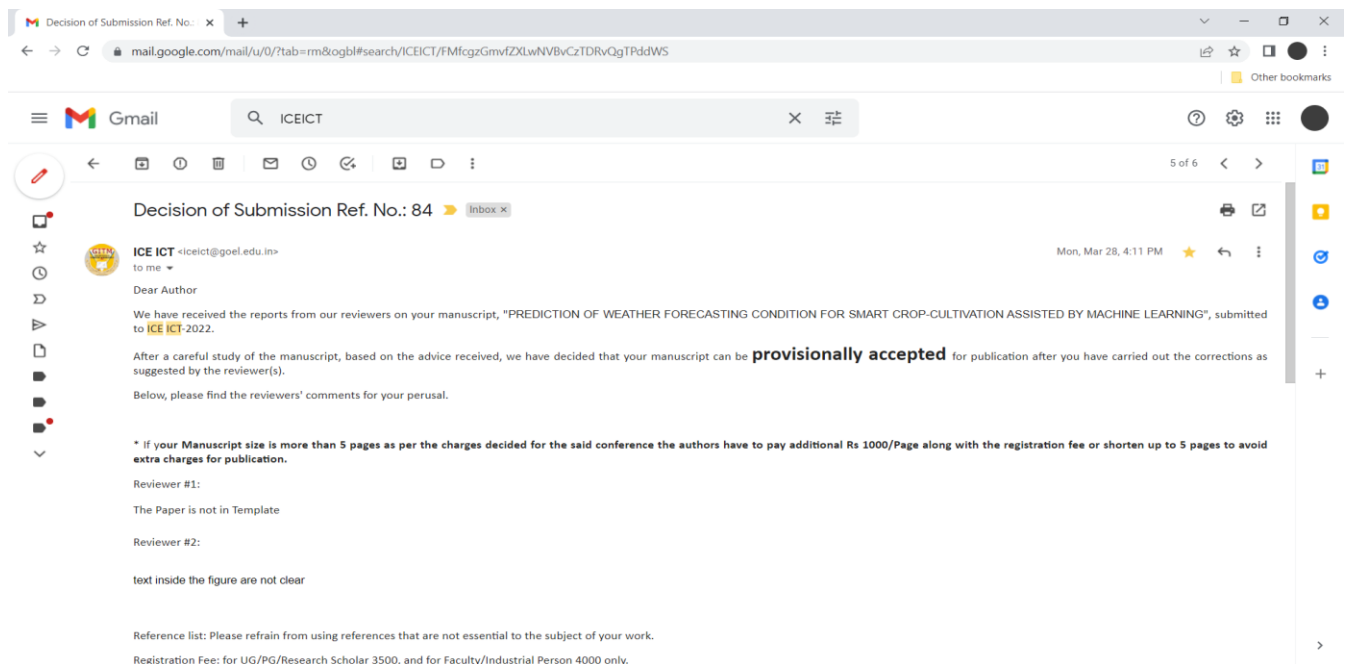


Figure.11 graph on clouds rain and clear sky

C.PUBLICATION WITH PLAGIARISM REPORT



PREDICTION OF WEATHER FORECASTING CONDITION FOR SMART CROP-CULTIVATION ASSISTED BY MACHINE LEARNING

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Abstract: This paper outlines a study that looked consider how machine learning regression techniques could be applied to forecast weather in agricultural fields for smart irrigation systems, crop selection, and agriculture. Farmers are increasingly relying on harvest time judgments in order to make sound crop management and financial decisions. Accurate crop output estimates can be immensely beneficial to decision-makers. In either case, using more weather-related features based on the harvest model will improve forecasting efficiency. In order to estimate crop production models, we developed an adaptable deep neural network architecture to analyze weather-related data in this article. The proposed model aims to forecast future harvest models using meteorological data from the previous year. By estimating future crop models based on weather-related data, farmers can take the necessary precautions or discontinue growing specific crops. The suggested model is designed to anticipate future crop models using weather-related data from the preceding year. As a result, farmers would be able to take appropriate adjustments or stop cultivating specific crops depending on future crop models projected using weather-related data.

Keywords: ML (Machine Learning), India's Weather Dataset, Weather Forecast, Agriculture, Temperature, Insecticides, Adaptive Deep Neural Network (ADNN).

1.Introduction

Agriculture is extremely important to the world economy. As the human population grows, the agriculture sector will be put under additional strain. Agri-Technology and precision farming, dubbed "digital agriculture" by some, are two new scientific fields that make use of data. Agriculture has a vital role in the global economy. With the world's population growing, it's more important than ever to understand global agricultural output in order to address food security concerns and mitigate the effects

of climate change. Crop yield forecasting is a major issue in agriculture. Weather factors such as rapid rainfall, temperature differences, pesticides, and other factors have a significant impact on agricultural yield. The weather forecast is a significant aspect that influences crop productivity. As a result, the weather forecast is anticipated, and plantings are selected based on the forecast. The use of science and technology to forecast the future atmospheric conditions of certain regions and time is known as weather forecasting. People have been attempting to predict the weather informally for thousands of years, particularly since the nineteenth century. Weather forecasts are made by collecting data on the current state of the atmosphere in a specific location and then using weather to predict how the atmosphere will change. Individual input is still required to select the best predictive model for forecasting. Farms are a key consumer of private weather forecasting organizations, and the benefits of better weather forecasting for agriculture are evident. The optimal time to plant, fertilize, irrigate, and harvesting crops is determined by the weather. Accurate weather data for every region of the farm can help farmers increase their productivity. Weather forecasting is useful not just for growing crops, but also for exporting them promptly. Many rural roads in the globe are dirt, and farmers must know when they are safe to use them. We use data from a specific location to estimate future weather conditions, assisting farmers in selecting the appropriate crops and irrigation methods based on changing weather circumstances. There are several methods for forecasting the weather, ranging from glancing up at the sky, which was used in ancient times, to complex computational models. In this situation, we use it by comparing weather patterns and predicting which crops will thrive in that environment we jumbled the crops and advised the best one to be planted sown based on the user's choices. Deep learning is a type where machine learning makes use of multi-layer neural networks (NNs). The study's principal deep learning technique was the convolutional neural network (CNN). In applications that need a large amount of data, such as picture recognition, CNNs are one of the most often utilized algorithms for showing complex operations and performing design recognition.

2.Literature Review

Abhinav Sharma et al, Arpit Jain et al, Prateek Gupta et al, V. Chowdary et al. (2021) "Machine Learning Application for Precision Agriculture: A Comprehensive Review" [1].

P.P. Pawade et al, Dr. A.S. Alvi et al. (2020) "Survey on Applications of Machine Learning in Agriculture" [2].

Gaurav Verma et al, Pranjul Mittal et al, Shaista Farhreen et al. (2020) "Real Time Weather Prediction System Using IOT and Machine Learning" [3].

Hu du et al, Eva Lucas Segarra et al, Carlos Fernandez et al. (2020) "Development of a Rest API for Obtaining Site-Specific Historical and Near-Future Weather Data" [4].

Jonathan A et al, Weyn, Dale R et al, Durran, Rich Caruana et al. (2020) "Improving Data-Driven Global Weather Prediction Using Deep Convolutional Neural Networks on a Cubed Sphere" [5].

R. Sharma et al, S. S. Kamble et al, A. Gunasekaran et al, V. Kumar et al and A. Kumar et al. (2020) "A systematic literature review on machine learning applications for sustainable agriculture supply chain performance" [6].

3. Proposed Work

3.1 Existing System

A Wireless sensor network (WSN)-based novel framework based on data collection and transmission is proposed to monitor air quality in current systems. The characteristics of the environment to be monitored are temperature, humidity, CO volume, CO₂ volume, and the detection of any gas leakage. The values of these parameters are relayed to a base station, which uses Zigbee Pro to monitor them (S-2). Temperature and air pressure readings are also transmitted through Bluetooth, allowing anyone within range of the system to confirm them on their own. Temperature and humidity values are also communicated through Bluetooth, allowing anyone within range of the equipment to confirm them. A text message appears when the volume of data exceeds a predetermined safe limit defined for a certain application.

3.2 Proposed System

The proposed model can be used to forecast future crop models based on past year's weather data. As a result, farmers can utilize weather-related data to forecast impending crop models and take appropriate safeguards, or they can completely abandon a particular crop. As a result, the suggested crop production model may be broken down into two stages: data collecting and future crop prediction. A variety of weather-related data for several Indian states is obtained during the data collection process. Because the suggested crop production model is being evaluated on cereals and pulses, historical crop data for crops under consideration is being gathered as well. Finally, during the stage of prediction, the

XGBOOST with AI classifier is used to project future crop production. A text message is sent to the addressee. The GSM module informs the base station when the volume of the base station exceeds a certain safe limit set for a given application.

3.3 System architecture

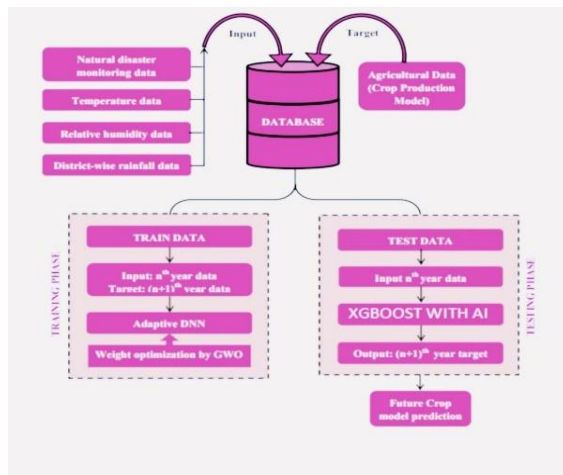


Figure.1 architecture diagram

4. Module Implementation

- Data Collection – In order to improve forecast precision, data collecting is essential. State-level monthly actual average temperature, minimum temperature, and air pressure data from various regions, such as different states in India, as well as data compiled from India's weather data, are among the weather-related data acquired at this stage. Surveillance Center These statistics are being used to forecast future crop yield. Kaggle [7].
- Pre-process the data - Data preparation is the process of converting raw data into an understandable format. Because we can't work with raw data, this is a critical stage in the data mining process, this is an important stage in the data mining process. because we can't operate with raw data. Before using machine learning or data mining tools, be sure the data is of good quality. There are NAN values in this data, and some of the items are duplicated. As a result, we'll get rid of that at this moment. For the nth year, enter data. As an output, a DNN that has been trained to adjust Data for (n+1)th year. The data from the nth year is used as input. The purpose is to use data from (n+1)th year. Analyze the data.

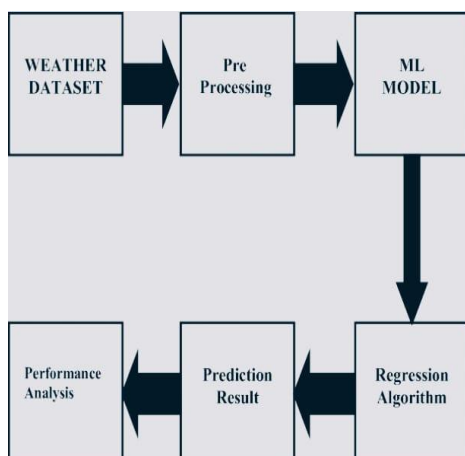


Figure.2 Data preprocessing flow diagram

- Analyze the data – The GWO algorithm provides findings based on an arbitrary population with the same number of weights as the number of weights necessary to exhaust all DNN weight possibilities. During each iteration, 10 solutions will be generated at random and compared to the previous best solution to quickly select the best result (weight matrix). When an ideal solution is discovered that outperforms the others, it is selected and saved. Grey wolves are recognized as Peak Predators after

effectively encapsulating a Canidae's contribution at the fortitude's feeding chain, precursors and supplying their area. To examine the congruence between scientific weather forecasting and ethno-meteorology, we analyzed farmers and weather scientists' views of the efficacy of two types of information. First, we investigated how farmers thought about the nature of both local and Western weather forecasting expertise, as well as how accurate are two sets of data are at predicting weather conditions.

•Prediction - This is the last stage, during which we forecast weather conditions that are suitable for crop selection and irrigation style selection, among other things. In the prediction stage, an adaptive DNN classifier is used to forecast future crop yield. In the following sections, the steps of the suggested crop production model will be explored in depth. Furthermore, the structure of the supplied Crop Production Model. Weather can also be used to determine the optimal times for planting, fertilizing, spraying, irrigating, and harvesting crops. Accurate weather data for every component of a farmer's operation can help them increase output of the farm. Forecasting the weather is helpful not just for growing crops, but also for quickly exporting them. The proposed model is provided for predicting crop models for the future based on weather data from prior years. As a result, farmers can utilize weather-related data to foresee impending crop models and take all required safeguards, or they can stop cultivating any given crop. As a result, the model of crop production proposed data collection and crop prediction in the future can be divided into two parts. Allow R_m to represent entering data and 1 Mm 'C' to indicate data leaving the system. For each set of n year data collection, an input R_m is weather-related data, such as Monthly Actual Average Rainfall (mm) by District, temperature, and relative humidity data.

5. Results and Discussions

The project's output will be $(n+1)$ year weather forecast. Based on climatic changes, an adaptive deep neural network architecture is developed for weather prediction. The technique is written in Python, and the testing is carried out on a system with 4 GB of RAM and an Intel I-5 processor. The weather history dataset, which contains temperature, wind speed, humidity, and other data, is provided as input.

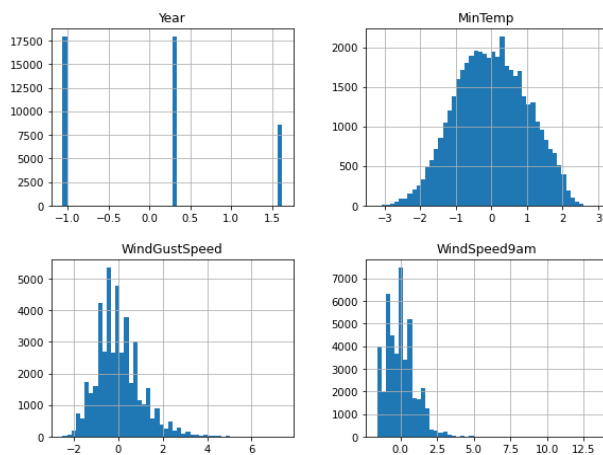
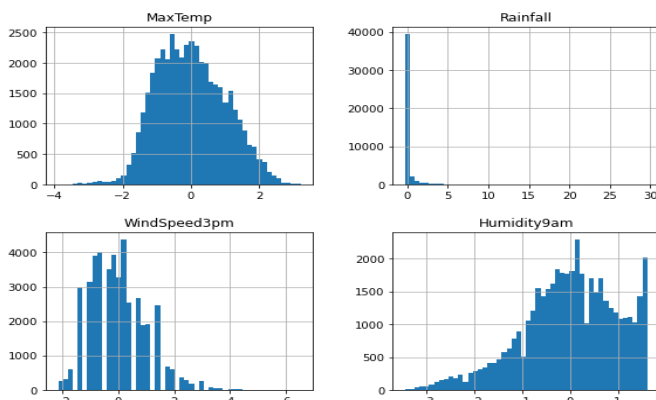


Figure.3 prediction of windspeed and wind direction



.4 prediction of max temperature, humidity

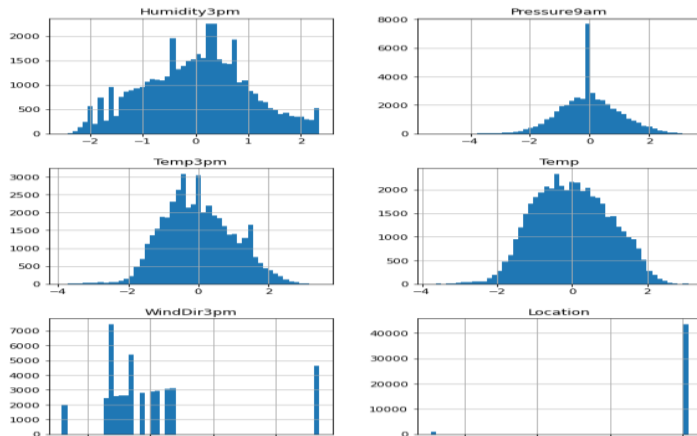


Figure.5 prediction of pressure and temperature at 3am

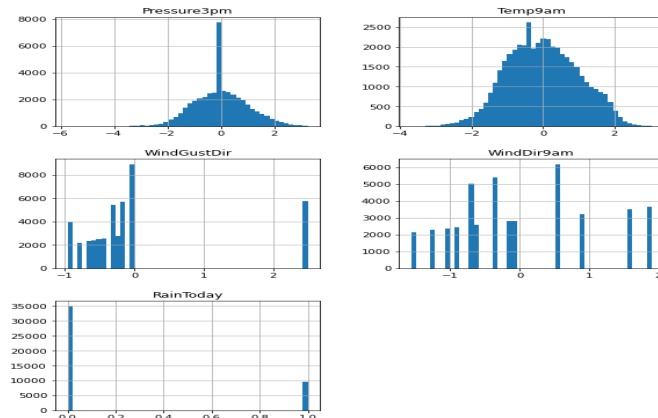


Figure.6 prediction of pressure and temperature at 3am

6. Conclusion

This study sheds light on one of the most important issues confronting Indian farmers: deciding which crop to plant based on weather forecasts. Governments and corporations spend billions of dollars each year on weather forecasting for good reason. Weather has a direct and indirect impact on every sector of the economy. The amount of weather-associated data available will continue to rise up, recent developments in machine learning are allowing government agencies and businesses to better utilize it all. Improved and hyper-localized weather forecasting allows a variety of organizations to save money — a minor reduction in field irrigation, a slightly more efficient flying path for an airline, a few hours faster in fixing an outage, and so on.

7. References:

- [1] Abhinav Sharma, Arpit Jain Prateek Gupta,V.Chowdary. Machine Learning Application for Precision Agriculture: A Comprehensive Review,2021.
- [2] P.P.Pawade, Dr.A.S.Alvi .Survey on Applications of Machine Learning in Agriculture ,2020.
- [3] Gaurav Verma, Pranjul Mittal, Shaista Farhreen.Real Time Weather Prediction System Using IOT and Machine Learning,1 March 2020.
- [4] Hu du, Eva Lucas Segarra, Carlos Fernandez (2020). Development Of a Rest API for Obtaining Site-Specific Historical and Near- Future Weather Data in EQW format UK 11-12.
- [5] Jonathan A. Weyn,Dale R. Durran,Rich Caruana. Improving Data-Driven Global Weather Prediction Using Deep Convolutional Neural Networks on a Cubed Sphere 12 August 2020.
- [6] R. Sharma, S. S. Kamble, A. Gunasekaran, V. Kumar and A. Kumar, "A systematic literature review on machine learning applications for sustainable agriculture supply chain performance", Computers and Operations Research, vol. 119, no. 7, 2020.
- [7]Dataset from "www.kaggle.com" .

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