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Kisan Mantra: Enhancing Farmer Productivity, A Web-Based Approach for Efficient Crop Harvesting and Problem Diagnosis

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Abstract

India's agricultural sector faces persistent challenges, including limited access to expert guidance, difficulties in managing diverse datasets, unreliable weather forecasting, and a lack of real-time monitoring for farm activities and crop quality. Additionally, farm lenders struggle to obtain accurate insights into farm productivity and risks, hindering their ability to provide tailored financial solutions. The sector also grapples with underemployment among educated professionals, limiting their contributions to agricultural advancement. To tackle these challenges, Kisan Mantra, a web-based platform, integrates machine learning-based weather prediction and connects farmers with skilled human operators who serve as agricultural advisors and technicians. The platform is overseen by an Administrator, ensuring effective management and seamless operation. Kisan Mantra not only enhances farm management efficiency but also fosters knowledge exchange between farmers and experts through interactive tools and data-driven insights. By leveraging artificial intelligence, it predicts crop diseases, optimizes irrigation schedules, and recommends suitable fertilizers based on soil health data. The platform supports decision-making through real-time analytics and promotes transparency in agricultural financing. Furthermore, it empowers rural youth by creating employment opportunities as field technicians and digital support agents. Through its holistic approach, Kisan Mantra bridges the technological gap in Indian agriculture, ensuring sustainability, improved productivity, and resilience against climate and market uncertainties.

Keywords: Farm visualization, weather prediction, centralized system, farmers

INTRODUCTION

Agriculture continues to be a crucial sector in the Indian economy, supporting a significant portion of the population. However, Indian farmers face persistent challenges, including unpredictable weather patterns, resource management issues, outdated farming practices, and limited access to advanced technologies. The gap in providing region-specific and farmer-centric digital tools exacerbates these problems, leaving farmers without the necessary resources to make informed decisions. To address these challenges, there is a growing need for affordable, accessible, and localized technological solutions that empower farmers to optimize their productivity and enhance financial inclusivity. The unpredictable and complex nature of weather makes traditional forecasting methods both tedious and challenging. Conventional approaches, such as numerical weather prediction (NWP) and weather radar, rely on solving intricate mathematical equations using advanced technology and scientific knowledge. These processes often demand expensive computational resources and complex

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physical infrastructure, yet their outputs are prone to inaccuracies, which can have severe societal impacts. [9] Similarly, research highlight that the erratic nature of weather increases the difficulty of forecasting, making it a resource-intensive and computationally demanding task. [2]

Weather forecasting involves predicting atmospheric conditions for a specific time, including factors such as rainfall, snowfall, temperature, fog, and wind. Various methods are used for weather prediction, including persistence forecasting, climatological forecasting, synoptic forecasting, statistical forecasting, and computational forecasting. [11] Weather forecasting has become the most difficult and crucial skill in today's information technology era, allowing us to anticipate the weather of any area. [10]

To overcome these limitations, we implement region-specific weather forecasting using a machine learning-based Random Forest classifier. Historical weather data, collected from Kaggle, spans from January 1, 2010, to February 20, 2024, comprising 123,937 rows and 20 columns, which were reduced to 1,021 rows and 7 columns after pre-processing for enhanced efficiency and accuracy. The model's performance was evaluated and compared against the Open Weather Map API, achieving a 90% above accuracy in predicting region-specific weather patterns (currently tailored to Fatehpur and Lucknow). This tailored approach ensures more reliable and localized forecasts, catering to the specific needs of Indian farmers. Additionally, the platform integrates farm mapping and visualization features using KML files, providing farmers with an interactive tool to effectively visualize and manage their farms. This empowers farmers with enhanced control over their agricultural practices, further supporting the platform's mission to provide valuable, actionable insights.

The platform also facilitates crop activity updates, enabling Farmers, Operators, and Admins to track and record activities with attached proof pictures for each update. This feature ensures transparent tracking of all activities, fostering collaboration and enabling real-time monitoring. By incorporating verified data, it supports informed decision-making, contributing to more efficient and effective farm management.

These activities are monitored structurally at 3 levels namely Admin, Operator and Farmer:

- Admin represent the top most level of the hierarchy, having the control over all the activities of the platform, features like adding operator region wise and farmers, assigning farmers to operators, adding crop variety, selection of crops, checking status, proof of events, duration of events, ml-based weather forecasting, KML file for visualization, Land Parcel and farmer reporting are accessible to admin.
- Operator represent the mid-level of the hierarchy, having control over farmers. This level consists features like adding farmers, weather forecasting, KML file, land parcels, monitor assigned crops, farmer reporting.
- Farmer represents the low level of the hierarchy, having features of registration, checking crop status, weather prediction, contact details of stakeholders and precautions available in Hindi and English language. The farmer can choose language according to his/ her ease.

LITERATURE REVIEW

B. Arulmanikandan, et. al. (2024); examine the transformative role of digital technologies in modern agriculture. The review highlights how tools such as mobile applications, the Internet of Things (IoT), big data analytics, and precision farming are revolutionizing traditional farming methods. These technologies enable farmers to access real-time information, optimize resource utilization, and make informed decisions, leading to increased productivity and sustainability. The authors also discuss challenges related to technology adoption, including infrastructure limitations, digital literacy, and data privacy concerns. The paper concludes by emphasizing the need for collaborative efforts among stakeholders to overcome these barriers and fully realize the potential of digital agriculture in empowering farmers. [4]

S. Murugan Bhagavathi, et. al. (2021); introduced a hybrid Numerical Weather Prediction (NWP) model aimed at enhancing the accuracy and efficiency of weather forecasting. Their approach combined the C5.0 decision tree algorithm with k-means clustering for short-term predictions. The k-means clustering method was employed to group similar datasets, which were sourced from the Modern-Era Historical Analysis for Research and Applications (MERRA). The processed dataset included key attributes such as temperature, pressure, humidity, wind speed, rainfall, snowfall, and snow depth. The model's performance was assessed using Mean Absolute Error (MAE) and Root Mean Square Error (RMSE), achieving a predictive accuracy of 90.18%. [3]

M. Hossain, et. al. (2020); a study conducted in 2020 focused on predicting the next day's temperature at any hour in Nashville, Tennessee, using various machine learning techniques. These included Support Vector Regressor (SVR), Ridge Regression, Multi-Layer Perceptron Regressor (MLPR), Random Forest Regressor (RFR), and Extra-Trees Regressor (ETR). After evaluating the models using RMSE, the study confirmed that machine learning techniques can provide weather predictions with accuracy comparable to traditional forecasting methods. [5]

N. Singh, et. al. (2019); proposed an innovative weather forecasting system that is cost-effective, reliable, and efficient. The system utilized machine learning techniques implemented in Python on a Raspberry Pi board. It collected real-time data on humidity, temperature, and pressure through sensors to determine the likelihood of rainfall on the same day. Historical weather data from Delhi over the past 20 years was used, with 75% allocated for training and 25% for testing. By applying the Random Forest Classification algorithm, the model achieved an accuracy of 87.90%. [6]

E. G. Petre, et. al. (2009); a weather prediction model was developed using attributes such as pressure, cloud cover, humidity, precipitation, and temperature. The model was tested with the CART decision tree algorithm, attaining an accuracy of 83%, though 16.67% of the instances were misclassified. Despite being trained on a limited dataset of only 48 instances recorded between 2002 and 2005, the model demonstrated promising predictive performance. [7]

I. Oshodi et. al. (2022); examines the use of machine learning techniques to improve weather prediction accuracy. The study utilizes machine learning models trained on publicly available weather data from Seattle (2012–2015) to forecast patterns effectively. The research demonstrates how machine learning can process large datasets, identify complex patterns, and enhance the precision of weather predictions compared to traditional methods. This work highlights the potential of machine learning in advancing meteorology by offering accurate and timely forecasts. [1]

O. O. Ayankemiet. al. (2024); evaluate the performance of three machine learning classifiers—Random Forest, Decision Tree, and Extra Tree—for weather forecasting. Utilizing a dataset from Kaggle containing weather records from 2006 to 2016, they trained, tested, and validated each model using Python's Scikit-Learn library. The study concluded that the Random Forest Classifier outperformed the others, achieving an accuracy of 66%, making it the most effective model among those tested for weather prediction in this research. [8]

OBJECTIVE

- Utilize machine learning techniques such as Random Forest to deliver region-specific weather forecasts, enabling farmers to make well-informed decisions based on precise and localized weather predictions.
- Facilitate farm visualization through the integration of KML files, enabling farmers to monitor and manage their land efficiently.
- Establish a robust connection between farmers and skilled human operators, who serve as agricultural advisors and technicians, delivering expert guidance on crop management, resource allocation, and farm activities.

- Offer a centralized system for real-time farm data management, ensuring seamless communication and coordination among all stakeholders, including administrators and operators.
- Enhance financial inclusion by providing farm lenders with reliable insights into farm productivity and risks, improving their confidence in granting agricultural loans.
- Address underemployment in the agricultural sector by creating opportunities for educated professionals to contribute as operators or advisors.

METHODOLOGY

Kisan Mantra employs a systematic and practical methodology to address the specific challenges faced by Indian farmers. The platform's methodology emphasizes region-specific solutions, leveraging modern technologies and human expertise to create an accessible and impactful agricultural tool.

System Design and Architecture

Kisan Mantra follows a Modular Architecture that Includes:

1. *Frontend:* Built using HTML, CSS, Bootstrap, and EJS for responsive and user-friendly interfaces.
2. *Backend:* Developed with Node.js and Express.js to ensure scalability and efficient server-side operations.
3. *Database*: MySQL is used to store user details, farm data, and weather information.

KML files are integrated to provide cost-effective farm boundary visualization. This feature allows farmers to define and monitor their land effectively.

Data Collection and Pre-Processing

- Historical weather data was sourced from Kaggle, covering January 1, 2010, to February 20, 2024, with 123,937 rows and 20 columns.
- Pre-processing steps included handling missing values, normalizing data, and engineering relevant features for model accuracy, the dataset was reduced to 1,021 rows and 7 columns, focusing on region-specific weather parameters.

Machine Learning Model Implementation

- A Random Forest classifier was employed for monthly weather forecasting, achieving high accuracy and reliability.
- The model was trained and validated using the pre-processed dataset and optimized through hyperparameter tuning.
- Its performance was compared against OpenWeatherMap API predictions, demonstrating superior accuracy for region-specific forecasts.

Human Operator Integration

- Unlike fully automated systems, Kisan Mantra relies on skilled human operators who act as agricultural advisors and technicians.
- Operators assist farmers by providing guidance on farm activities, resource management, and interpreting weather forecasts.
- The platform is supervised by an administrator responsible for managing operator assignments and ensuring the smooth operation of the system.

User Interface Development

The user-friendly dashboard consolidates weather forecasts, farm visualization, and operator communications into a single interface.

Testing and Validation

- Rigorous testing was conducted to ensure system reliability, including unit tests, integration tests, and user acceptance tests.

- The accuracy of weather forecasts was validated against real-world data, achieving over 90% accuracy.

MODULES

Admin Module

This module serves as the backbone of the system, ensuring smooth functionality and management. Administrators oversee user accounts, assign operators to specific farms based on location and expertise, monitor system performance, and handle any troubleshooting requirements. Additionally, they are responsible for maintaining data integrity and ensuring the secure operation of the platform. This module acts as the central control unit, ensuring all components of the system work cohesively as shown in Figure.2

Operator Module

This functions as a critical intermediary between the platform and the farmers. Operators provide expert agricultural advice and assistance tailored to the needs of individual farmers. They communicate directly with farmers to guide them on crop management, resource allocation, and activity planning. Operators also monitor farm activities and submit progress reports to the administrator, ensuring that farms operate efficiently. By interpreting weather forecasts and offering actionable advice, operators bring a human element to the platform, making it more accessible and reliable.

Farmer Module

This module is designed to empower farmers by providing them with essential tools and resources for farm management. Farmers can view region-specific weather predictions, access actionable farming insights, and visualize their farm boundaries using KML-based mapping tools. The module includes a user-friendly dashboard that allows farmers to upload reports, communicate with assigned operators, and track their farm activities comprehensively. This module ensures that farmers have the information and support they need to make informed decisions and improve productivity.

Weather Prediction Module

This delivers accurate and region-specific monthly weather forecasts. This module leverages historical weather data to generate reliable predictions using a Random Forest algorithm. The forecasts are validated against external APIs to ensure accuracy and are displayed in an intuitive format on the farmer dashboard. The incorporation of machine learning ensures that farmers can plan their activities with confidence, mitigating risks associated with unpredictable weather.

Farm Visualization Module

This enhances the platform by enabling efficient monitoring and management of farm boundaries and resources. By utilizing KML files, this module provides cost-effective and precise mapping capabilities. Farmers can define and visualize their farm boundaries interactively, allowing for better resource allocation and management. This approach eliminates the need for expensive GIS tools, making it accessible to small-scale farmers.

User Authentication Module

This module employs role-specific authentication mechanisms for farmers, operators, and administrators. It features secure login processes with encrypted data storage and supports advanced security features such as password recovery and multi-factor authentication. By maintaining a robust authentication system, Kisan Mantra safeguards user information and ensures that platform access is restricted to authorized individuals.

Contact Module

This enables structured communication between administrators, operators, and farmers. The administrator can contact both farmers and operators, ensuring efficient dissemination of information.

Operators serve as intermediaries, communicating with both administrators and farmers to provide technical assistance and resource management. Farmers can contact operators for guidance on crop management, weather forecasts, and farm-related queries. The module utilizes a database-driven messaging system for secure and accessible communication, enhancing collaboration, problem resolution, and real-time support to improve agricultural productivity.

Language Selection Module (Hindi/English)

This enables farmers to choose between Hindi and English as their preferred language. Once selected, the preference is stored in session storage, ensuring that the interface updates automatically without requiring users to select their language again during their session.

FUNCTIONS

User Authentication Function

The platform's user authentication module is pivotal in ensuring secure and role-based access for all users. This module implements mechanisms to assign specific permissions to farmers, operators, and administrators, ensuring that each user interacts with the platform according to their role as shown in Figure 1 &2.

Dashboard Functions

The dashboard function serves as a centralized hub for users to access critical information and manage activities effectively. This feature provides a user-friendly interface displaying real-time metrics, such as mapped farm areas, active crops, weather conditions, and farmer reports. It allows administrators to oversee system performance, operators to monitor assigned tasks, and farmers to track agricultural activities. The integration of interactive data visualization tools, such as maps and charts, ensures that all users can derive actionable insights effortlessly, fostering better decision-making and operational efficiency as shown in Figure 3.

Farmer Function

ADMIN and OPERATOR can view FARMER's details and add new farmer profiles directly through the platform. The farmer management interface is designed to be user-friendly, allowing administrators and operators to input farmer data, including personal details, farm specifics, and contact information as shown in Figure 4.

Land Parcel Function

This function enables users to add new land parcel details to the platform. This feature includes input fields for the land name, associated farmer name, area (in acres), pin code, state, district, and village. It ensures that all necessary details are captured for efficient farm management. Additionally, this function supports integration with mapping tools to visualize the added land parcels as shown in Figure 5.

Assigned Crops

The assign crop function allows users to link specific crops to land parcels effectively. This feature includes the following input fields: Crop Name, Farmer Name, Land Parcel Name, Variety, Crop Season, Brand of Crop, Start Date and Action. By capturing these details, the function ensures that crop management is structured and easily accessible for farmers and administrators.

Crops Activity

The crops activity function tracks and manages the ongoing activities related to assigned crops as shown in Figure 6.

Reports Function

This function will have farmer's report by which ADMIN AND OPERATOR will get to know more about the farm. This function utilizes Data Analysis techniques to get the information on farm.

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Admin Function

This function is specific to ADMIN who has control over other functions of Users (farmers), Operators, Crops and its activity, Variety of crop and Brand of crops.

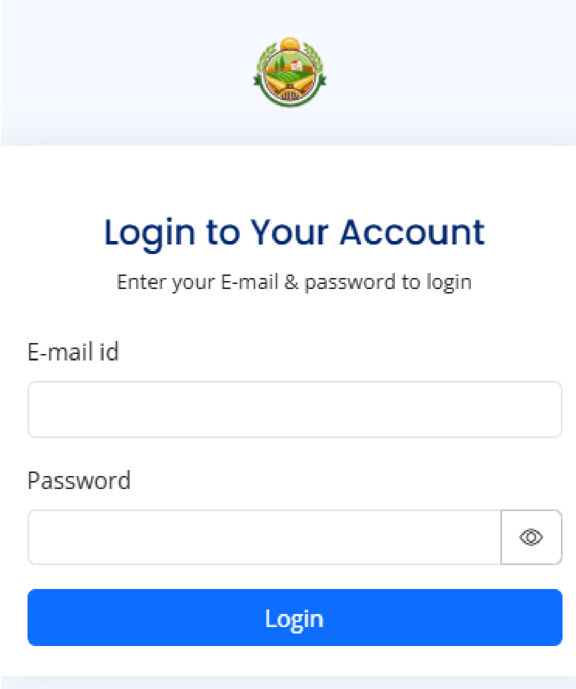

Figure 1. Login Page of Kisan Mantra.

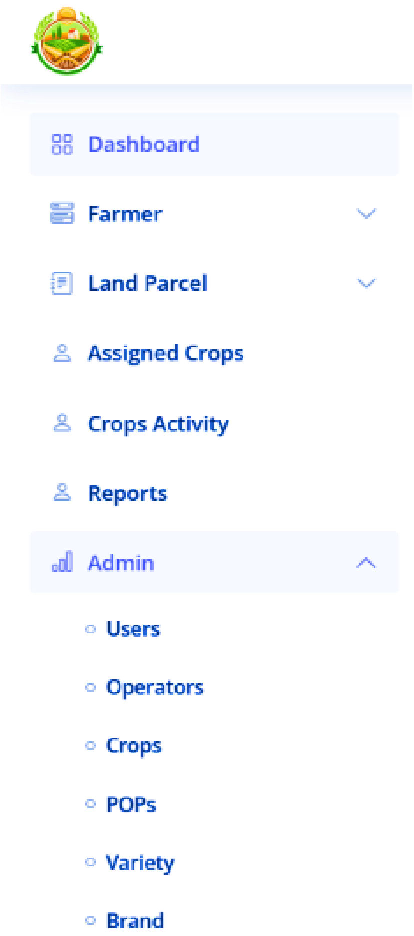

Figure 2. Admin Functions.

Contact Function with Language Adaptation

The contact function in the Kisan Mantra platform is designed to facilitate seamless communication between farmers and agricultural experts while ensuring accessibility through a language adaptation mechanism. This function enables farmers to submit their queries in either Hindi or English, catering to their linguistic preferences and enhancing user engagement.

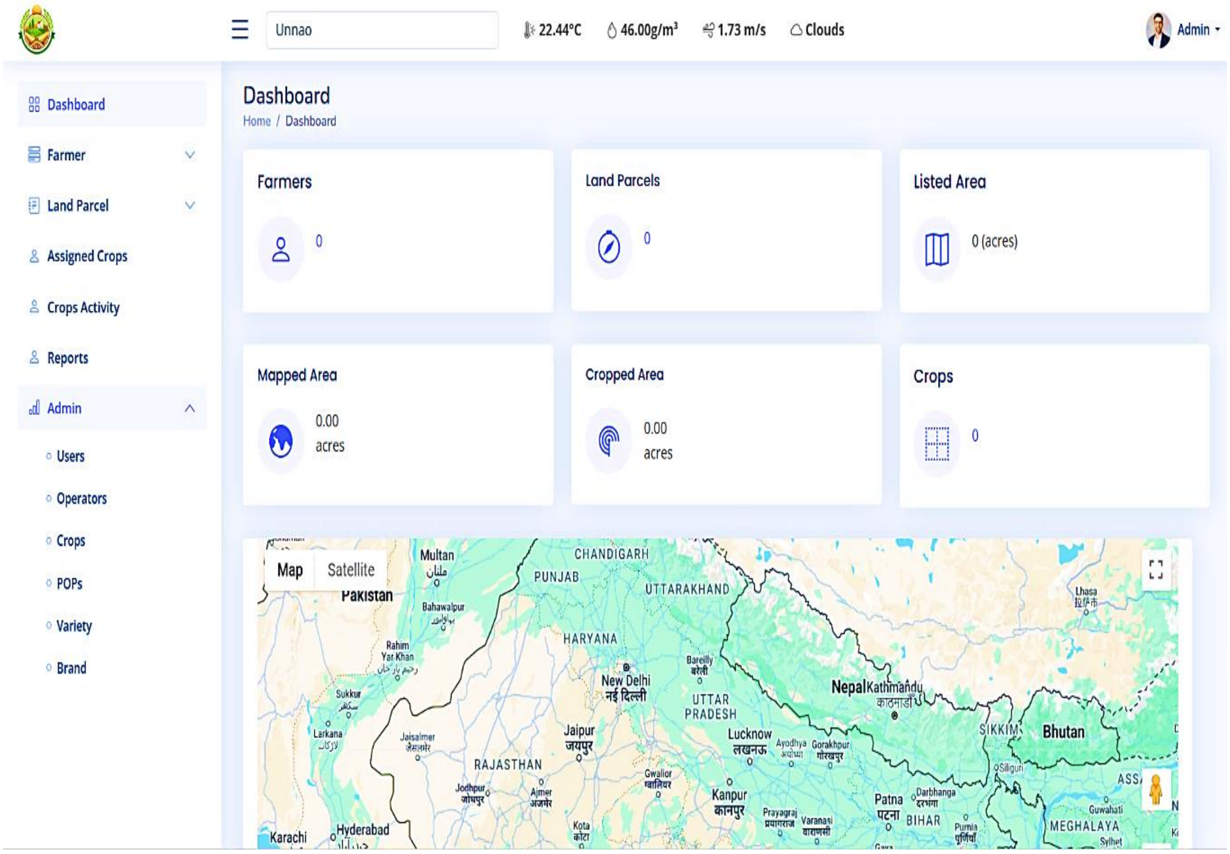

Figure 3. Admin Dashboard.

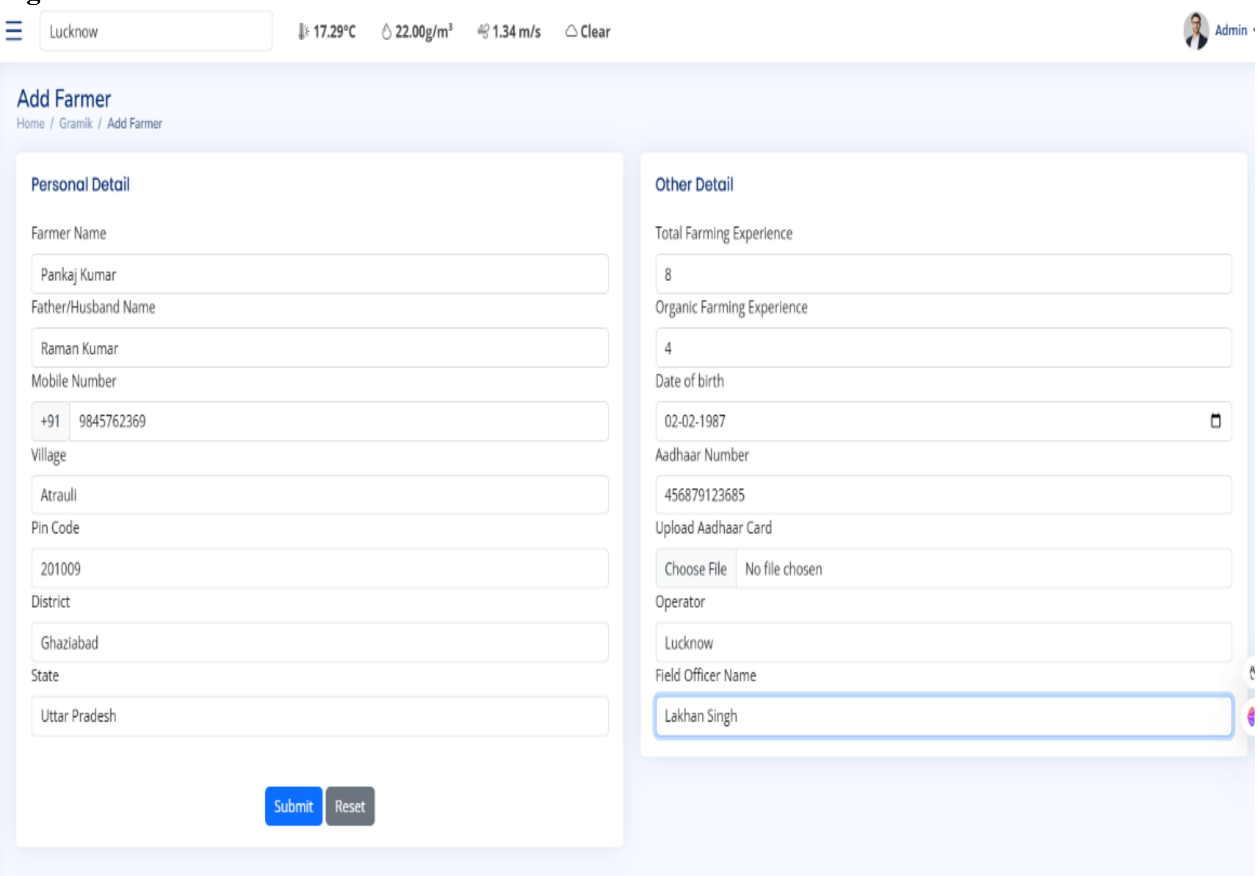

Figure 4. Farmer's Registration.

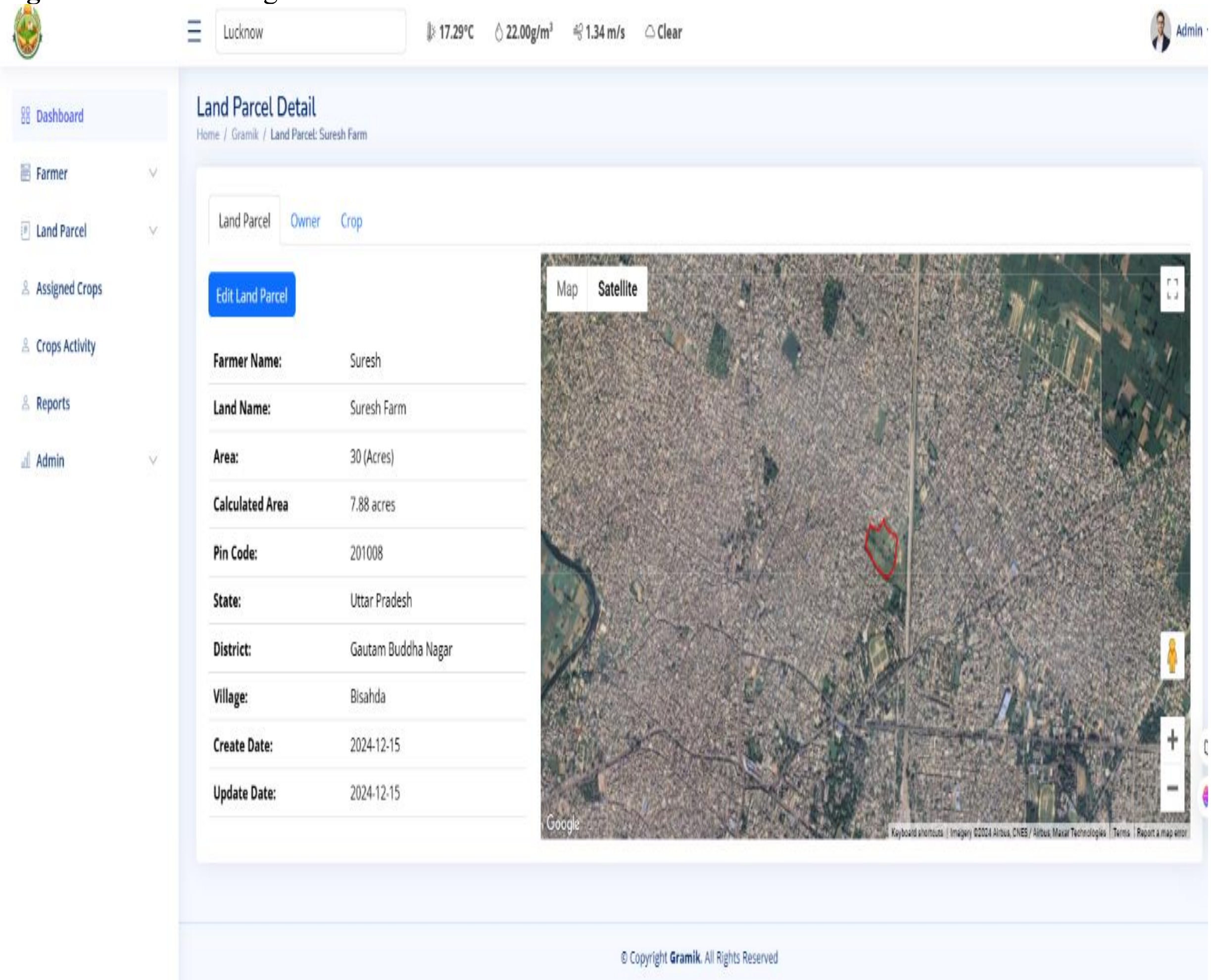

Figure 5. Land Parcel Details.

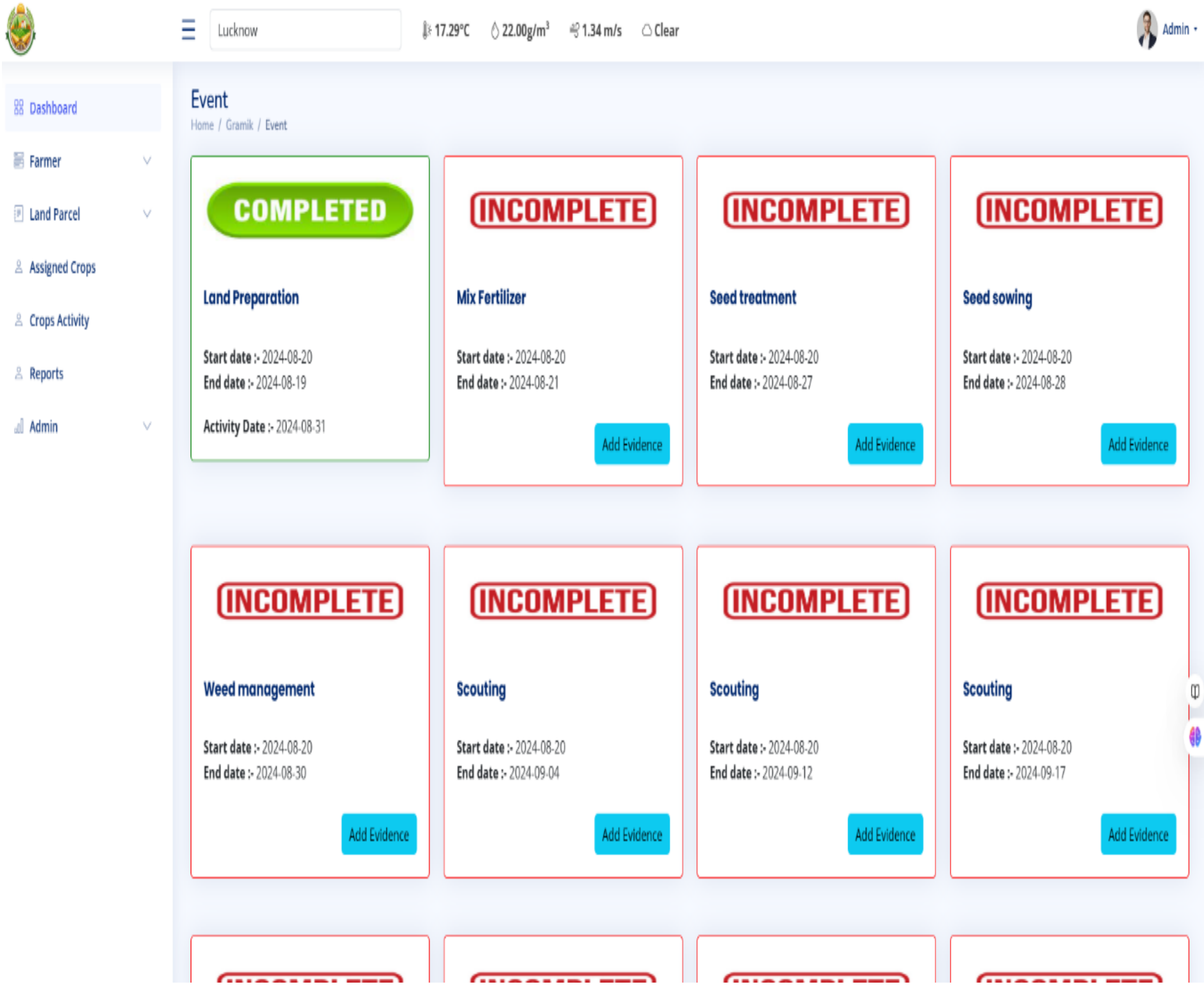

Figure 6. Crop Status Updation.

SYSTEM DESIGN

Use Case Diagram

A Use Case Diagram is a Unified Modeling Language (UML) diagram that depicts how users or external systems (actors) interact with a system to achieve specific objectives. It offers a broad overview of the system’s functionality by showcasing different user interactions as shown in Figure 7.

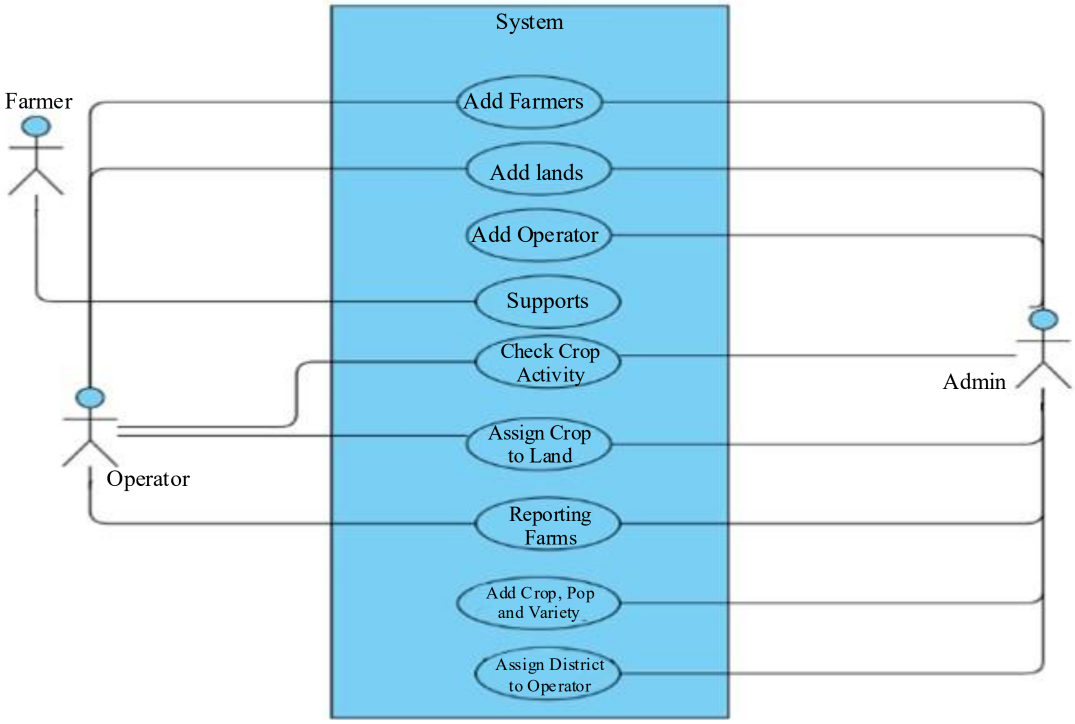

Figure 7. Use Case diagram of Kisan Mantra.

Client-Server Architecture

Kisan Mantra employs a client-server architecture to facilitate seamless communication between users (clients) and backend servers. This framework enables real-time interactions, efficient data processing, and scalability to accommodate a growing user base.

Technological Stack

The platform is constructed with the help of contemporary web technologies, for instance on front end uses HTML, CSS, Bootstrap, and EJS, and MySQL for data storage, and the backend server uses Node.js and Express.js. Flexibility, speed, and compatibility with a broad variety of devices and browsers are guaranteed by this tech stack. Python and its libraries are utilized for Machine Learning using Random Forest algorithm.

Responsive Design

Kisan Mantra implements responsive design principles to deliver an optimal user experience across multiple devices, including tablets, desktops, smartphones, and laptops. The interface enhances accessibility and usability by dynamically adapting its layout and content based on screen size and orientation.

Process Diagram

Process flow diagrams illustrate the progression of a specific process or system, showing how different inputs—such as materials, energy, or data—are transformed into outputs, including products, services, or outcomes. Unlike a basic list or textual explanation, a PFD visually represents the sequence of operations, decisions, and pathways involved in the process as shown in Figure 8.

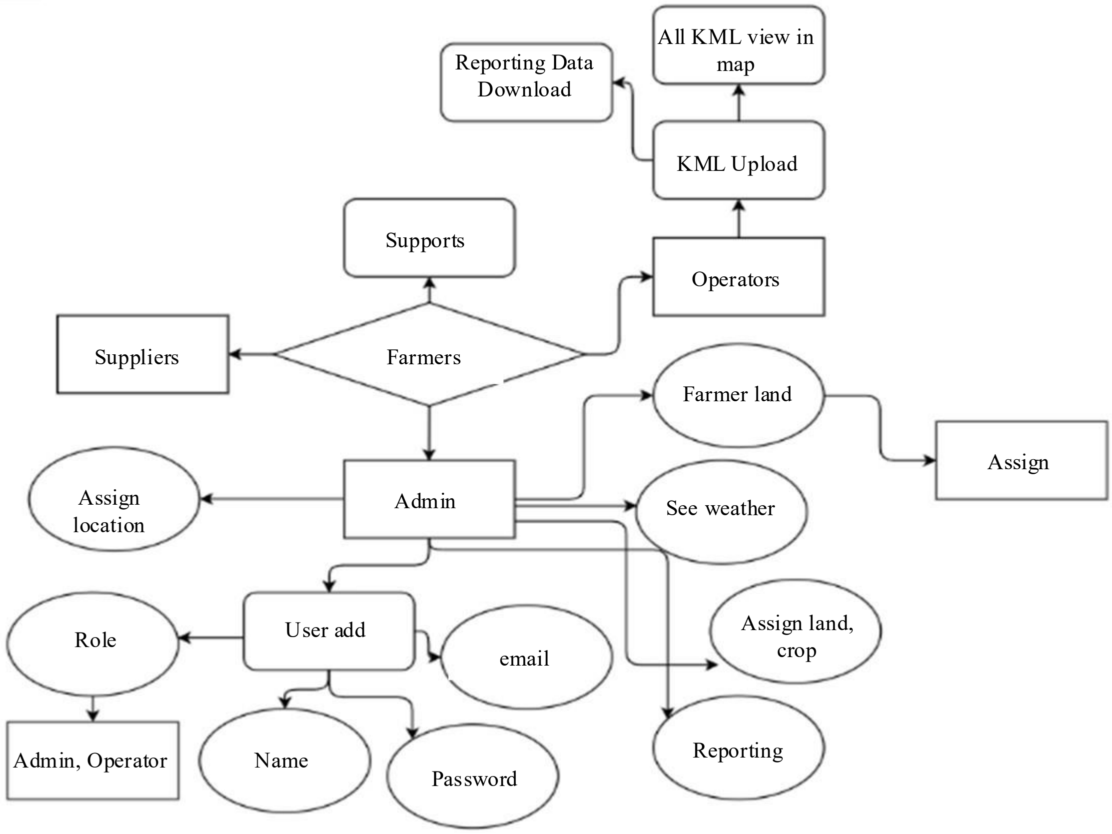

Figure 8. Process Diagram of Kisan Mantra.

PROCESSES

The process of developing and implementing the KISAN MANTRA agricultural technology (AgTech) platform involves several stages, each aimed at achieving specific objectives and milestones. The process encompasses the following key phases:

Project Kick-off

The project kickoff phase initiates the development process, where the team sets a clear direction by outlining objectives, goals, and key parameters. This stage includes defining the project scope, identifying essential stakeholders (such as farmers, agricultural specialists, and local authorities), and formulating a timeline along with a structured project plan.

Requirements Gathering

During the requirements gathering phase, end-users such as farmers, agricultural specialists, and other stakeholders are actively involved to understand their needs, preferences, and expectations. This process may include surveys, interviews, focus groups, and feedback sessions to collect both qualitative and quantitative data on crop management, yield prediction, weather forecasting, and farm activity monitoring.

System Design

In the system design phase, the collected requirements are translated into a detailed system architecture. This stage includes specifying technical requirements, choosing suitable technologies and frameworks, designing user interfaces (UI), and developing wireframes and prototypes to represent the platform’s structure and functionality. The design prioritizes ease of use for both farmers and administrators.

Implementation

This phase involves the actual development of the KISAN MANTRA platform, following the predefined system design and requirements. It includes coding, assembling and integrating different modules such as weather forecasting, farm activity management, and incident reporting. Additionally, database structures are implemented, and rigorous testing is conducted to validate functionality, performance, and reliability. The platform will also incorporate machine learning models for crop yield prediction and weather forecasting.

Deployment

The deployment phase focuses on readying the KISAN MANTRA platform for its production launch. This process involves setting up servers and infrastructure, configuring deployment environments, deploying application code and databases, conducting integration and acceptance testing, and ensuring seamless compatibility across various devices and browsers used by farmers.

Training And Documentation

The training and documentation phase is dedicated to equipping end-users, such as farmers and administrators, with the knowledge to efficiently operate the KISAN MANTRA platform. This includes creating user manuals, tutorials, and instructional materials, organizing training sessions and workshops, and offering continuous support to help users navigate the platform and utilize its features effectively.

Evaluation and Iteration

The evaluation and refinement phase focuses on collecting feedback from users and stakeholders, tracking platform performance, and analyzing usage data. This process helps pinpoint areas for enhancement, including user experience, weather forecasting precision, data analysis, and overall system functionality. Continuous improvements will be made based on the insights gathered.

RESULT

A key feature of KISAN MANTRA is its real-time data management system, which centralizes farm information and facilitates seamless communication between farmers, operators, and administrators. This system also aids farm lenders by providing them with accurate insights into farm productivity and risks, enhancing their ability to offer tailored financial solutions. The platform's holistic approach to agricultural challenges ensures that farmers receive the support they need to improve productivity while also promoting financial inclusion and providing economic opportunities in the sector.

In comparison with existing algorithms, such as those discussed in the paper "Machine learning-based algorithms for weather forecasting" by Ismaila Oshodi, the Random Forest Classifier implemented in KISAN MANTRA achieved an accuracy rate of over 90%, outperforming other methods in terms of forecasting precision. This highlights the robustness of the chosen machine learning approach and its potential for transforming weather prediction and farm management in India’s agricultural sector.

The pair plot visually represents the relationships between key weather variables used in your prediction model, which has achieved over 90% accuracy. The diagonal histograms show the distribution of each feature: temperature (15–30°C), relative humidity (30–90%), precipitation (mostly low values with rare peaks), and wind speed (normally distributed around 7–10 m/s). The scatter plots highlight key correlations. Temperature and humidity have a strong inverse relationship—higher temperatures correspond to lower humidity. Precipitation is more likely at lower temperatures and higher humidity levels, showing a non-linear trend. Wind speed exhibits a weak correlation with other variables, indicating a limited role in prediction. The dataset’s strong dependencies between temperature, humidity, and precipitation likely contribute to the high model accuracy. These insights confirm the reliability of the dataset and its predictive power for weather forecasting shown in Figure 9.

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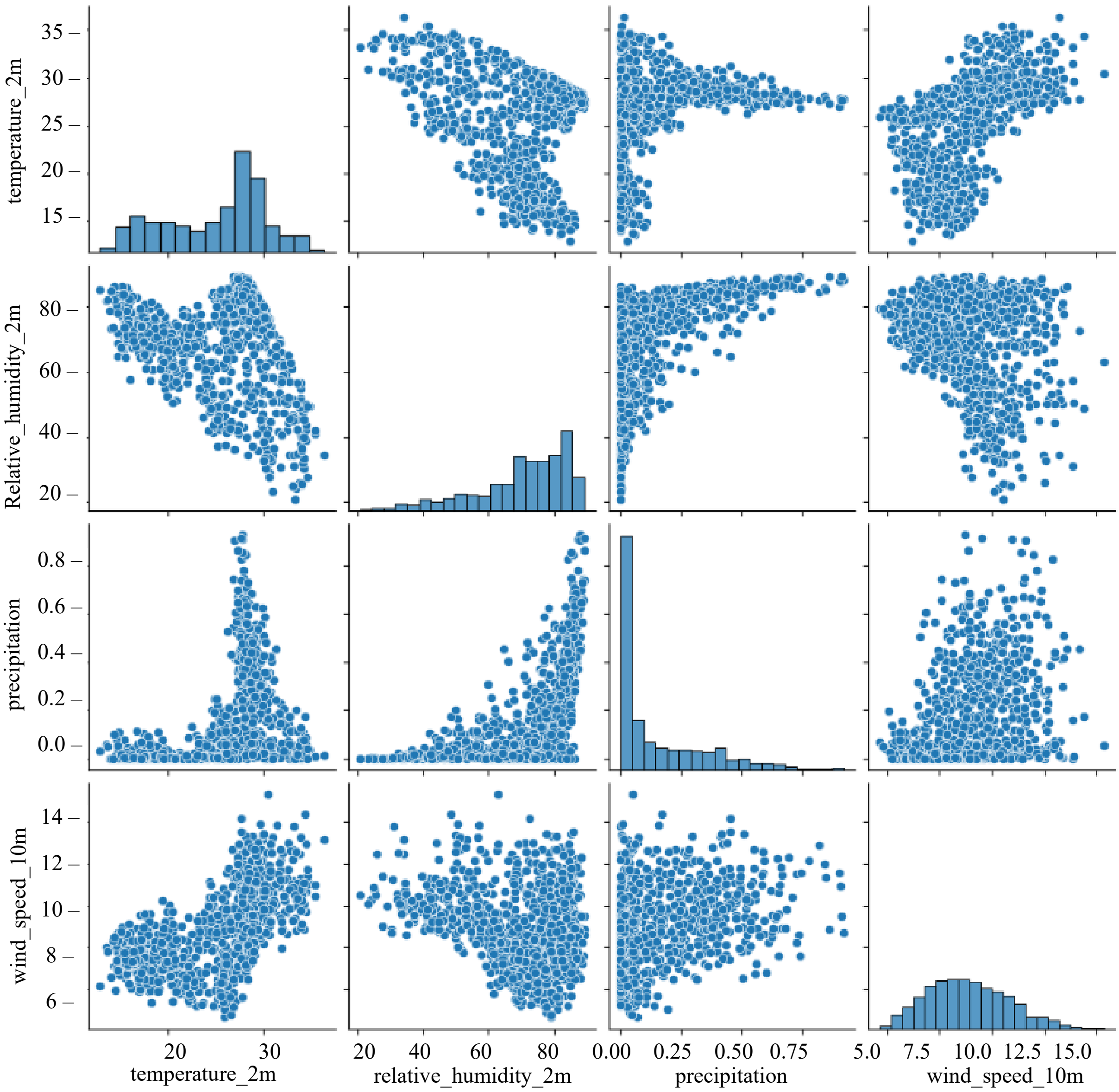

Figure 9. Pair Plot for Fatehpur.

The correlation matrix provides a comprehensive analysis of the relationships between various meteorological parameters, which is essential for optimizing our weather prediction model. Strong positive correlations, such as between temperature at 2m and apparent temperature (≈0.99), indicate redundancy, allowing us to remove one of these variables to prevent overfitting. Similarly, dew point temperature and relative humidity exhibit a strong correlation, reinforcing their interdependence in atmospheric moisture levels. Conversely, strong negative correlations, such as pressure and precipitation (≈-0.70), reveal crucial dependencies, indicating that lower atmospheric pressure is often associated with increased rainfall, a key factor in storm prediction. Moderate correlations between wind speed and pressure further validate their role in defining weather patterns. Weak or near-zero correlations suggest variables with minimal predictive value, which can be excluded to improve computational efficiency. By leveraging these insights, our machine learning-based weather forecasting model effectively selects the most influential features, leading to higher accuracy in monthly weather predictions for Lucknow and Fatehpur within the Kisan Mantra project shown in Figure 10.

The resulting accuracy of the weather forecasts was validated against collected real-world data, achieving over 90% accuracy. As demonstrated in Figure 3, the current weather predictions for Fatehpur indicate clear conditions, with s metrics including a predicted temperature of 26.25°C, humidity at 29.08%, wind speed of 3.70 m/s, and gusts reaching 7.28 m/s, along with a wind direction of 5.00 degrees. This data reflects the system's capability to provide accurate and actionable weather information shown in Figure 11.

The classification model demonstrated an impressive exact accuracy of 92.65%. The confusion matrix revealed the model's performance with a true positive count of 120 for clear weather and 69 for rainy weather, alongside false positives of 7 and false negatives of 8, respectively. The classification report highlighted precision, recall, and f1-score metrics, showcasing a precision of 0.94 and a recall of 0.94 for clear days, while rainy days achieved a precision of 0.91 and a recall of 0.90. The overall accuracy was reported at 0.93, with both macro and weighted averages matching these metrics. The analysis of actual versus predicted weather indicated discrepancies, particularly where clear conditions were inaccurately classified as rainy. The model's predictions for today's weather included a predicted temperature of 26.25°C, 29.00% humidity, a wind speed of 3.70 m/s, and wind gusts reaching 7.28 m/s. This detailed evaluation confirms the model's robust predictive capabilities while also highlighting areas for improvement in classification accuracy, particularly concerning clear and rainy weather differentiation shown in Figure 12.

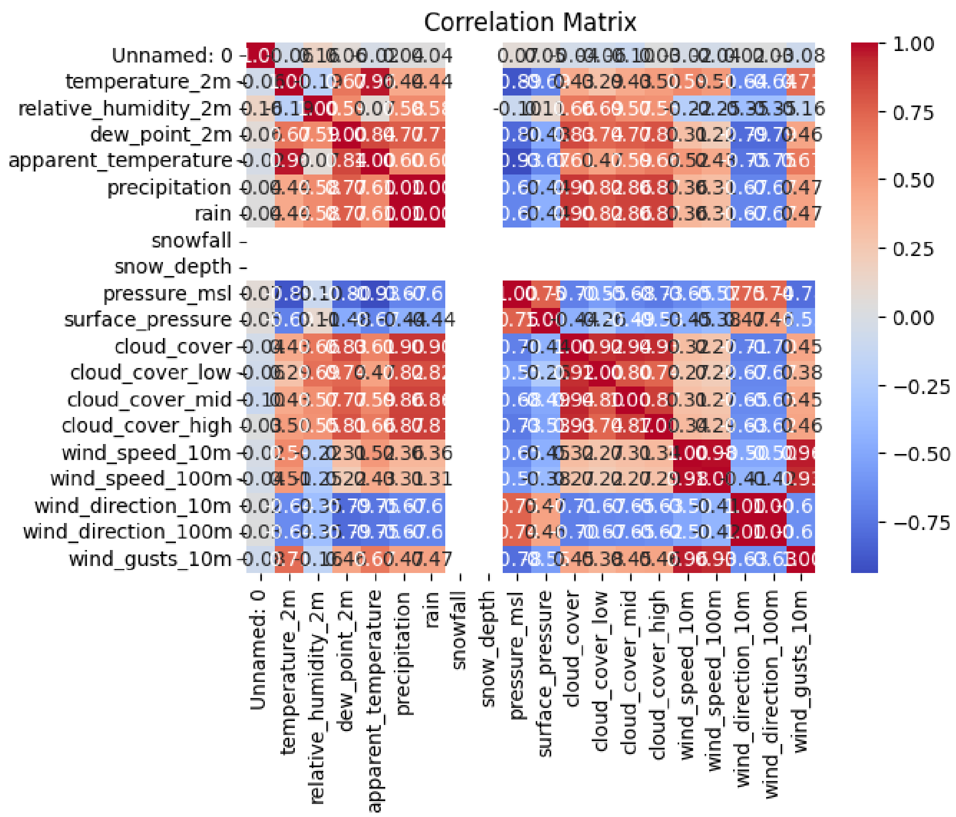

Figure 10. Correlation Matrix for Fatehpur.

```
Today's Predicted Weather: Clear
Predicted Temperature: 26.25 °C
Predicted Humidity: 29.00%
Predicted Wind Speed: 3.70 m/s
Predicted Wind Direction: 5.00 degrees
Predicted Wind Gusts: 7.28 m/s
```

Figure 11. Fatehpur’s weather prediction


```
Exact Accuracy: 92.65%
Confusion Matrix:
 [[120   7]
 [  8  69]]
Classification Report:
               precision    recall  f1-score   support

           0       0.94      0.94      0.94       127
           1       0.91      0.90      0.90        77

    accuracy                           0.93       204
   macro avg       0.92      0.92      0.92       204
weighted avg       0.93      0.93      0.93       204

Actual vs Predicted Weather:
   Actual Weather Predicted Weather  Temperature (Celsius)
0          Clear             Clear              19.692521
1          Rainy             Rainy              28.626583
2          Clear             Rainy              31.933061
3          Rainy             Rainy              28.307438
4          Clear             Clear              21.919153
Model and Label Encoder saved successfully!
```

Figure 12. Fatehpur Weather Prediction accuracy.

CONCLUSION

India's agricultural sector is burdened with numerous challenges, including unreliable weather forecasting, inadequate expert guidance, and the difficulty of managing diverse datasets. In response to these challenges, the KISAN MANTRA platform was developed as a web-based solution that leverages machine learning to provide region-specific weather forecasts and improve farm management practices. By integrating the Random Forest algorithm for weather prediction, the platform ensures that farmers receive accurate, localized weather updates, empowering them to make more informed decisions regarding their crop management and farm activities. The platform further facilitates efficient farm management by incorporating KML files for farm visualization, enabling farmers to track and manage their land more effectively. Additionally, KISAN MANTRA fosters a strong connection between farmers and skilled human operators who act as agricultural advisors and technicians, providing expert guidance on crop management, resource allocation, and other essential aspects of farm activities. This connection not only enhances farm productivity but also opens up opportunities for educated professionals to contribute to the agricultural sector, addressing the issue of underemployment.

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