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# A Machine Learning-Based Weather Forecasting Integrated With AI Chatbot for Smart Agriculture

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## ABSTRACT

Agricultural management is highly influenced and perfectly organized based on the weather conditions, accurate forecasting helps to increase the crop yield productivity and maintain agricultural activities in a better way. The proposed methodology provides a system that integrates both advanced XGBoost and Long Short-Term Memory (LSTM) models techniques with a multilingual chatbot for forecasting the accurate weather condition and suggests advanced crop monitoring techniques as a recommendation for Precision farming. The Integrated Multilingual chatbot suggests farmers with appropriate recommendations on fertilizer agricultural techniques, irrigation, plants management, and harvesting plans. XGBoost is a trained model particularly used for identification of nonlinear climate patterns for accurate forecasting measures. LSTM monitor and captures temporal dependencies in forecasting weather parameters such as temperature, rainfall, and humidity. This system results show that the integration of both advanced hybrid XGBoost and LSTM techniques achieves higher prediction accuracy and lower weather prediction error than traditional methodology systems. This feature enables improved resource utilization and results in high yeild productivity.

**Keywords:** Smart Agriculture, Precision Agriculture, Weather Forecasting, XGBoost Model, Hybrid Machine Learning Model, LSTM (Long Short-Term Memory), Deep Learning, Artificial Intelligence in Agriculture, Agricultural Decision Support System, AI Chatbot.

## I. INTRODUCTION

Advance weather forecasting technology plays a vital role in accessibility and usability of this climate information for rural farmers to improve their crop productivity and maintain the agricultural activities. A lot of farmers struggle to access this real time climate information due to lack of knowledge about this weather prediction system. To overcome this problem statement a multilingual chatbot will help them to understand the current weather forecasting information easily and decide their crop management and harvesting plan accordingly to suitable weather conditions. This multilingual chatbot supports and simplify the climate insights and provide personalized precision farming guidance in an simple format. This makes farmers to make informed decisions based on the weather condition and also improves fosters digital inclusion in urban communities.

This paper aims to help farmers in analyzing their real time problems in agriculture through an integrated Advanced AI Models that combines both LSTM and XGBoost for weather forecasting prediction with a multilingual interface chatbot. Farmers can share their location by latitude and longitude values as a text input or through GPS—and the workflow begins by capturing live climate data for that addressed location to forecast parameters such as temperature, rainfall, and humidity.

The combination of capturing the live climate forecasting and suggests the effective agricultural measures helps a lot for rural farmer to improve their crop productivity. Further, the chatbot's ability to communicate in regional languages such as Tamil, Hindi, and others improves accessibility and adoption among farmers with low literacy levels or limited technological proficiency.

## II. METHODOLOGY

### *A. Work Flow*

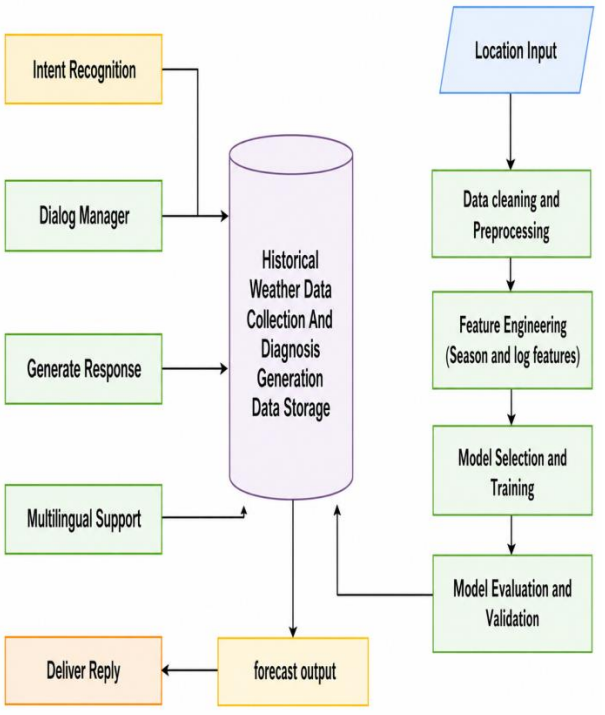


**Fig 1:** Proposed Weather Forecasting Integrated with AI Chatbot for Smart Agriculture System



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The proposed methodology focuses on creating an AI powered weather forecasting system for precision farming, integrated with an advanced, multilingual chatbot interface to provide best practice recommendations. This system uses XGBoost for machine learning techniques and LSTM for deep learning models. It integrates predictive modeling to emphasize high accuracy in weather prediction, appropriate agronomic measures, accessibility, and organized resource optimization.

**a. Objectives of the Proposed System**

- **Predictive Weather Forecasting:** Accurately predict key climatic variables such as temperature, humidity, wind speed, and rainfall using XGBoost for short term analysis and LSTM for long term analysis.
- **Multilingual Interactive AI Chatbot:** Assist farmers in maintaining crop production by offering validated recommendations and suggestions at the right time using weather prediction trained models.
- **Prevents Resource Loss and Optimization Practice:** Reduce wastage of resources such as water and fertilizer by offering optimal schedules based on predicted weather and crop maintenance.
- **Accessibility and Inclusivity:** Reduce risk and ensure convenience for farmers through natural language interaction and multilingual support in a well-organized manner.
- **Data Preprocessing:** Collect data using valid latitude and longitude provided by farmers. After collection, extract data from the cloud and preprocess it by removing noise, applying filtering and scaling, and finally normalizing inputs for feature selection.

**b. Model Training:**

- **XGBoost for sequential tabular weather data:** Analyze nonlinear relationships and salient features from the preprocessed data and use pretrained models for prediction.
- **LSTM for time series sequences:** Learn temporal patterns in temperature, rainfall, and humidity to emphasize accurate weather prediction, leveraging Tensor Flow based training.
- **Prediction & Forecasting:** Short term forecasts of nonlinear relationships are generated by the XGBoost model, while long term sequential forecasts are generated by the LSTM model. The forecasts are combined to provide comprehensive, accurate, and optimized weather predictions.
- **Integration with AI Chatbot:** Predictions are sent to the cloud and retrieved by the AI chatbot, which answers queries in natural language to improve ease of use.

***B. Efficiency of XGBoost and LSTM***

- **XGBoost Efficiency:** Effectively handles feature selection, accommodates missing data, and reduces noise in weather data, supporting advanced machine learning practices. It regulates overfitting and enhances feature selection, making it suitable for short term, tabular predictions where historical patterns vary frequently.
- **LSTM Efficiency:** Captures long term dependencies in weather data and mitigates vanishing gradient issues found in traditional RNNs. It is ideal for modeling trends, seasonality across regions, and cyclic patterns in climate.

***C. Python Code Snippets***

Input data set after preprocessed from the cloud. Split data for the trained models to allocate their corresponding weather forecast.

```
Example dataset: features = ['temperature', 'rainfall', 'wind_speed','humidity']
a = weather_prediction_data [['temperature', 'rainfall', 'wind_speed', 'humidity']]
b = weather_prediction_data ['next_day_temperature']
```

## III. RESULT AND DISCUSSION

Weather parameters were predicted for multiple locations, including Maduravoyal, Porur, Ambattur, Vellore, and Arni, using the proposed hybrid XGBoost–LSTM forecasting model. The predicted outputs include temperature (°C), humidity (%), rainfall (mm), and wind speed (km/h), which is an essential factor for agricultural planning and decision-making.



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**TABLE I.**
**TABULAR DATA REPRESENTATION**

| Location | Coordinates (Lat & Long) | Forecast (Sample Data) | Immediate Action | Crop Health Measures | Soil & Irrigation Management | General Agricultural Maintenance |
|---|---|---|---|---|---|---|
| **Chennai – Avadiar** | 13.12, 80.25 | Temp: **34°C**, Humidity: **68%**, Wind: **12 km/h**, Rain: **20%** | Evening irrigation to reduce evaporation | Use neem oil or sticky traps to prevent thrips & pests in vegetables | Apply organic mulch to conserve soil moisture | Maintain crop spacing for better air flow and disease prevention |
| **Chennai – Perar** | 13.04, 80.15 | Temp: **32°C**, Humidity: **72%**, Wind: **10 km/h**, Rain: **30%** | Skip irrigation; save water for next 2–3 days | Spray copper fungicide to prevent leaf spot in brinjal & chilli | Strengthen bunds to prevent waterlogging | Collect & store rainwater for later irrigation |
| **Chennai – Maduravoyal** | 13.07, 80.18 | Temp: **35°C**, Humidity: **65%**, Wind: **14 km/h**, Rain: **25%** | Irrigate in the morning to prevent heat stress at night | Stake tall crops (papaya, maize) to withstand winds | Apply potash to improve heat resilience | Schedule soil moisture testing to avoid over-irrigation |
| **Kanchipuram – Tiruverrambai** | 12.62, 79.28 | Temp: **30°C**, Humidity: **70%**, Wind: **7 km/h**, Rain: **65%** | Prepare drainage channels to prevent waterlogging in fields | Spray *Trichoderma* for paddy blast prevention | Avoid nitrogen application (risk of nutrient leaching) | Store harvested grains properly to prevent moisture damage |
| **Vellore – Sathuvachari** | 12.91, 78.13 | Temp: **29°C**, Humidity: **75%**, Wind: **6 km/h**, Rain: **20%** | Apply chemical spray (late may need off) | Apply Mancozeb to groundnut fields to prevent leaf spot | Prevent overwatering for low-lying areas | Store seeds/fertilizers in airtight containers to avoid spoilage |

Table I represent the captured live forecasted weather parameters data for the provided locations. The tabular represents structured dataset of climatic variations across various regions in Tamil Nadu.

The predicted values were captured from the comparisons of historical weather observations and this analysis ensures the high forecasting accuracy in the calculated values. The hybrid AI Model XGBoost–LSTM technique captured both the nonlinear climate pattern relationships and temporal weather dependencies within the specific regional data, leading to both the reliable short-term and long-term climate predictions and also adds on with the integrated multilingual Chabot supports rural farmers to understand the situation and take needed agricultural activities according to the predicted climate.

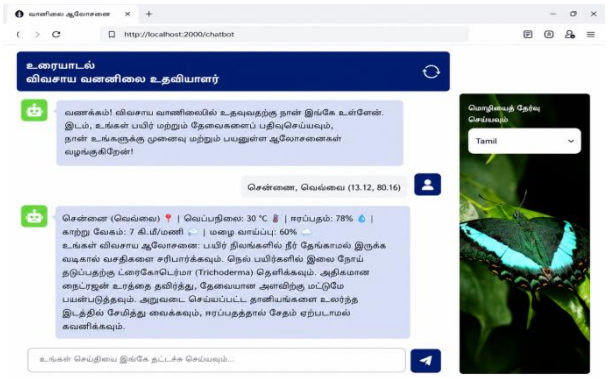


**Fig. 2.** Weather Forecasting with AI Chatbot for Ambattur in Tamil

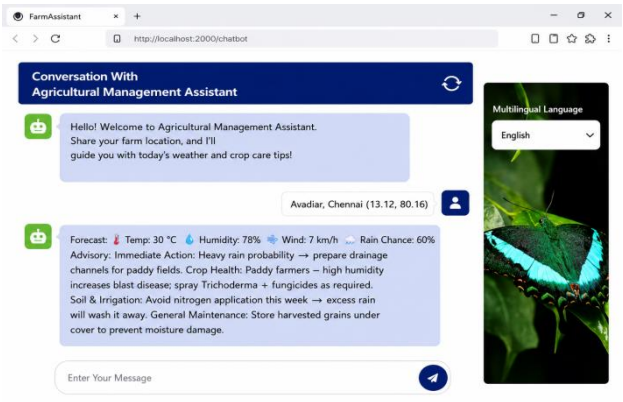


**Fig. 3.** Weather Forecasting with AI Chatbot for Ambattur in English

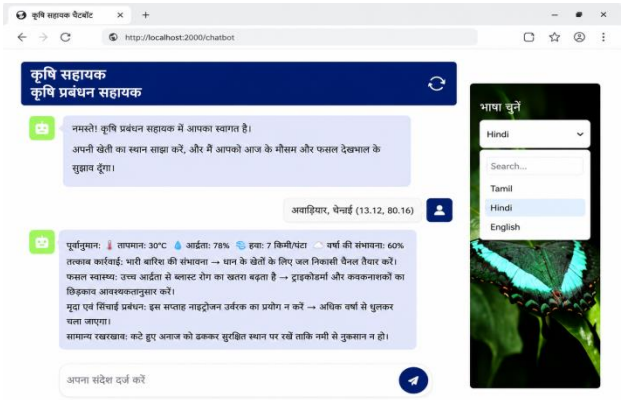


**Fig. 4.** Weather Forecasting with AI Chatbot for Ambattur in Hindi

Figure 2, 3, 4 shows Chennai–Ambattur location with this latitude and longitude geographical coordinates 13.12°N,



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80.16°E, which enables the hybrid AI models used weather prediction chatbot interface system developed for the Agricultural management system which recommends best advisory action as a output. The system supports English, Hindi, and Tamil languages, which helps farmers to understand and communicate with the chatbot which makes the entire process easy and make the communication in their preferred regional language. The system provides real-time weather forecasting information, which includes the following values as temperature of 34°C, humidity of 66%, wind speed of 11 km/h, and a rainfall probability of 20%, along with best plant advisory and agricultural management recommendations captured from the input coordinates.

## IV. CONCLUSION

This research presents an AI-powered weather prediction system and AI Chatbot which helps in agricultural decision-support system that integrates hybrid models of XGBoost (nonlinear climate patterns) and LSTM (temporal dependencies) with a multilingual AI chatbot. The hybrid approach effectively captures nonlinear patterns and temporal bridges the gap between advanced machine-learning techniques and practical agricultural decision-making, contributing to improved resource utilization, reduced crop losses, and enhanced weather resilience. Integrating predictive models with conversational AI provides a user-friendly and effective solution for precision-farming applications.

The proposed system can be further extended by incorporating additional data sources from IoT devices and chatbot can be integrated with plant-disease detection to provide best-practice treatment recommendations and to accommodate climate variability.

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