IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

CROP PREDICTION AND TRANSLATION USING MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

[1]Dr. K. Swapna,[2]Syed Eliyaz Ahamed,[3]Tirumalasetti Kavya Sri

[1]Assisstant Professor(Ad-hoc),[2]Student,[3]Student

[1,2,3]Information Technology and Computer Applications,

[1,2,3]Andhra University College of Engineering, Visakhapatnam,India

Abstract:This paper, "Crop Prediction and Translation using Machine Learning and Artificial Intelligence," aims to develop a user-friendly web application for farmers and stakeholdersas agriculture plays a vital role in human lives. This application can help them to interact easily to get the resulting crop, suggestions, and measures for farmers in their preferred language.The application integrates machine learning and artificial intelligence to predict suitable crops based on input climate and soil data. Users can input data through text, audio, or parameter selection and choose their preferred language for suggestions. Advanced machine learning algorithms like logistic regression and XGBoost are used to predict suitable crops. The application also utilizes Gemini Pro's content generation capabilities to provide personalized suggestions and measures to farmers, enhancing agricultural practices. The use of the ensemble algorithm XGBoost increases the model's accuracy. The project not only provides crop prediction but also offers knowledge and decision support, contributing to advancingagricultural practices and productivity.

Index Terms–Machine Learning,Generative AI,XGBoost,Artificial Intelligence,Logistic Regression.

I.INTRODUCTION

In this paper developed a comprehensive web application designed to assist farmers and agricultural stakeholders.Using the internet only the model can be able to run as internet has become the necessary factor for everything [1]. It integrates various technologies, including machine learning, natural language processing, and translation capabilities, to deliver a multifaceted solution for better improvement of crop selection and decision-making processes. At its core, the application uses machine learning models, like Logistic Regression and XGBoost, trained on agricultural data. These models predict the most suitable crops based on input values such as nitrogen levels,phosphorus levels,potassium levels, soil pH levels,temperature, humidity, and rainfall[2]. They analyze historical agricultural data to make informed predictions regarding crop suitability under different climatic conditions.The application also incorporates Google's Generative AI for content generation, providing users with valuable insights and suggestions on cultivation practices, pest management, and other relevant factors. It offers multiple input modes, including text, audio, or parameter selection, catering to diverse user preferences and technological capabilities. The application processes user queries and generates responses in the user's preferred language, enhancing usability and accessibility.Furthermore, the application serves as an educational tool, raising awareness about the intricate relationship between climatic conditions and crop suitability [3]. It provides insights into agricultural best practices, sustainable farming methods, and the impact of environmental factors on crop productivity. The application also incorporates a parameter selection mode, allowing users to input specific climatic conditions through interactive sliders and receive tailored predictions and recommendations to the users.

II.LITERATURE REVIEW

Anjali Singh et al. [4] discuss the importance of agriculture production and the challenges it faces due to changing climatic conditions. It emphasizes the role of nutrients in crop production and the need for regulated nutrient management to increase crop production.

Dr. Reshmi Welekar et al. [5] Examine farming environments and situations to identify the best parameters and data for enhancing crop production, utilizing data mining and machine learning methodologies.

Akhil Varma, et al [6] Strive to assist agriculturists in choosing the appropriate crop at the ideal time, and in determining the best distribution of land and water resources for each crop. This is done with the goal of profit maximization, taking into account factors such as market rates, weather conditions, and available irrigation systems.

A. Saranyaet al. [7] discuss the multi-objective optimization problem of crop planning. It explores the challenges faced by agriculture, such as irrigation water management, land allocation, climate change, and resource utilization, which can be controlled by effective crop planning.

Vinay Gautam et al. [8] propose a gray wolf optimization-based deep learning approach to suggest better crops based on chemical and climate conditions. It considers different chemical factors, such as pH, nitrogen, phosphorus, and potassium, and various climate factors, such as rainfall, temperature, and humidity, to suggest crops to farmers.

Abhinav Sharma et al. [9] discuss how machine learning is being used in the field of agriculture. It highlights the major applications such as supply chain optimization, crop selection, logistics, crop yield prediction, soil data analysis, and weather data analysis.

Feng Liu et al. [10] introduce the application status of machine learning in various fields of agriculture and prospects for the application of machine learning in agricultural production. It also shows how knowledge agriculture improves the sustainable productivity and quality of products to enable plant yield prediction, weed testing, and species testing.

Ersin Elbasi et al. [11] survey AI applications in the agricultural sector. The discussion begins with foundational knowledge of AI, encompassing all AI techniques employed in the realm of agriculture. This includes machine learning, the Internet of Things (IoT), expert systems, image analysis, and computer vision.

III.PROBLEM STATEMENT

In this paper develop a web page need to assist farmers and agricultural stakeholders in making informed decisions regarding crop selection and cultivation practices. Despite increasing technologies, many farmers struggle with identifying the most suitable crops for their specific climatic conditions and optimizing their agricultural practices accordingly. This often leads to suboptimal yields, resource waste, and financial losses. The key challenges addressed by:

Crop Suitability Prediction: Developing accurate predictive models to determine the most suitable crops based on various climatic factors such as temperature, humidity, rainfall, soil properties, and nutrient levels [12]. This involves analyzing historical agricultural data and training machine learning models capable of providing reliable crop recommendations.

Expert Advice and Recommendations: Providing farmers with expert advice and recommendations tailored to their specific crop predictions and cultivation requirements. This includes guidance on crop varieties, planting schedules, pest management strategies, irrigation techniques, and soil amendments to optimize crop productivity and minimize risks.

Multilingual Support and Accessibility: Ensuring accessibility and usability for a diverse user base by incorporating multilingual support and intuitive user interfaces. This involves leveraging natural language processing and translation capabilities to accommodate users with different language preferences and technological proficiency levels.

Real-Time Interaction and Feedback: Facilitating real-time interaction between users and the application through text input, audio input, or parameter selection. This requires seamless integration of speech recognition, translation, and content generation modules to enable dynamic communication and feedback loops.

Education and Awareness: Serving as an educational tool to raise awareness about sustainable farming practices, environmental conservation, and the impact of climatic factors on crop productivity. This involves providing informative content, visualizations, and interactive features to empower users with knowledge and insights into modern agricultural techniques.

IV.METHODOLOGY

Requirements Gathering: Understand the needs of farmers and stakeholders regarding crop prediction and agricultural guidance. Identify the features and functionalities required in the application.

Research and Planning: Explore relevant machine learning algorithms for crop prediction, translation APIs for multilingual support, and generative AI models for response generation. Plan the integration of these technologies into the application.

Data Collection and Preprocessing: Gather agricultural data containing features like nitrogen, phosphorus, potassium levels, temperature, pH, humidity, and rainfall, along with corresponding crop labels. Prepare the data by managing null values, transforming categorical variables into numerical form, and normalizing numerical attributes. The dataset is obtained from the Udemy platform.

Model Development: Develop ML models such as logistic regression and XGBoost for crop prediction based on preprocessed data. Train the models using historical agricultural data to predict the most suitable crop given the climatic conditions [13].

API Integration: Integrate with translation APIs to provide multilingual support for input queries and generated responses. Utilize generative AI models to generate personalized responses based on predicted crops and user input.

Interface Design: Design a user-friendly interface using the Streamlit framework, allowing farmers to input queries through text, audio, or manual entry of climatic conditions. Ensure ease of use and accessibility for users.

Testing and Validation: Test the application for accuracy, reliability, and performance. Validate the predictions and generate responses against known data and expert knowledge. Gather feedback from users and stakeholders for improvements.

Deployment: Deploy the application locally using Streamlit for initial access. Optionally, expose the application to the internet using tools like localtunnel for remote access.

The Algorithms like Logistic regression and XGBoost algorithms were used in this model.

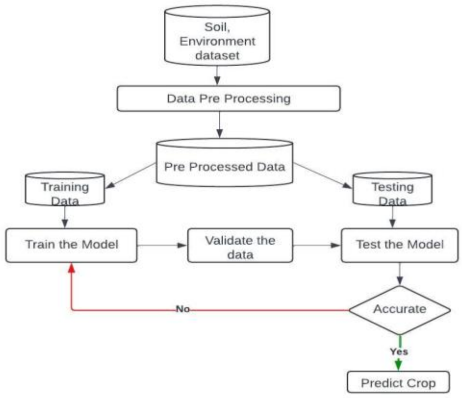

Fig. 4.1: Crop Prediction Methodology

Working of the Logistic Regression in the methodology process:

Step 1: Data Preparation: The process begins with a dataset that includes input features (climatic conditions) and corresponding binary labels (crop types).
Step 2: Model Training: In this phase, the Logistic Regression algorithm is used to learn the relationship between the input features and the probability of each crop type. This is achieved using a sigmoid function.
Step 3: Parameter Estimation: The algorithm estimates the model's coefficients (parameters) that minimize the error between the predicted probabilities and the actual labels in the training data.

Working of the XGBoost algorithm in the methodology process:

Step 1: Initialization: XGBoost begins with a single decision tree, serving as the initial weak learner.
Step 2: Gradient Calculation: It calculates the gradient of the loss function in for to the predictions of the current model.
Step 3: Tree Building: A new decision tree is built to minimize the loss function by fitting the negative gradients. This tree is then added to the ensemble.
Step 4: Regularization: XGBoost applies regularization techniques, such as pruning and feature subsampling, to control the complexity of the trees and prevent overfitting.
Step 5: Boosting Rounds: The process iterates through multiple boosting rounds. Each round adds a new decision tree to the ensemble and refines the model's predictions.
Step 6: Prediction: Finally, XGBoost combines the predictions of all trees in the ensemble to make the final prediction for a given input.

Streamlit:
Streamlit is a widely-used Python library that enables the creation of dynamic web applications.In this project, Streamlit is utilized to create a user-friendly interface for crop prediction and translation applications.
Streamlit allows developers to write simple Python scripts to create web applications without needing to write HTML, CSS, or JavaScript code.
With Streamlit, developers can easily incorporate data visualization, user inputs, and dynamic outputs, making it ideal for rapid prototyping and deploying machine learning applications.
In this project, Streamlit is used to collect user inputs (such as text queries, audio recordings, or numerical parameters) and display the predicted crop types and translations generated by the model.

Generative AI:

Generative AI, particularly large language models (LLMs) like GPT (Generative Pre-trained Transformer), is used for content generation and natural language understanding [14].

In this project, Generative AI, possibly in the form of GPT-based models, is used to generate responses and suggestions for farmers based on input queries or prompts.

The Generative AI model is trained on large datasets of text, enabling it to understand human language patterns and generate contextually relevant responses.

By utilizing Generative AI, the application can provide personalized suggestions, recommendations, and translations to farmers based on their input queries or parameters.

V. RESULTS AND DISCUSSION

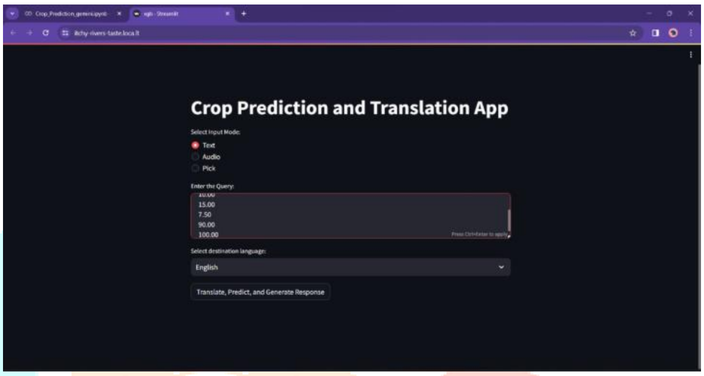

Fig. 5.1: Result 1

The above Fig. 5.1 displays the input type mode selected as text, and now the values should be entered, which are the environmental values and soil values.

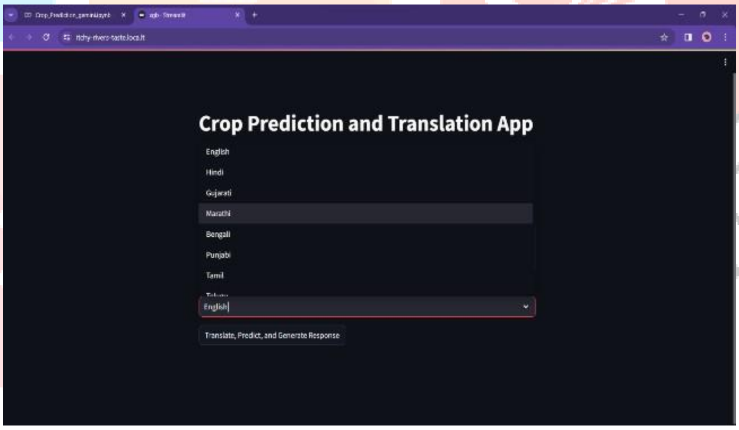

Fig. 5.2: Result 2

The above Fig. 5.2 displays the options for language selection. There are different types of languages users can choose from.

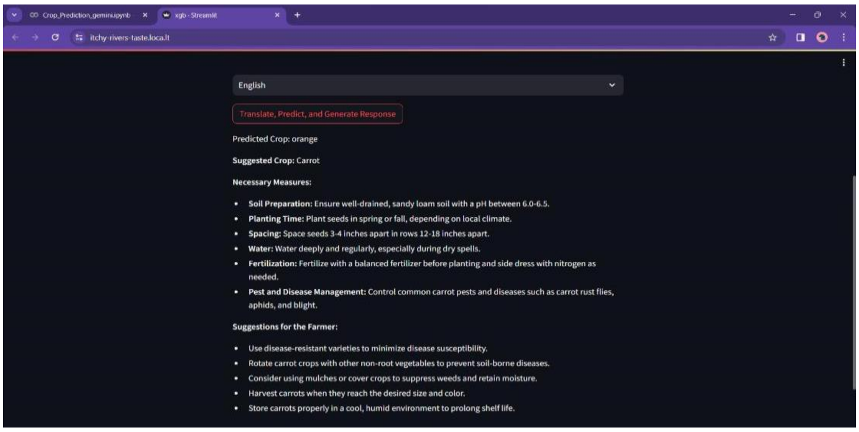

Fig. 5.3: Result 3

The above Fig. 5.3 displays the crop prediction and suggests feedback regarding the crops to the user after clicking the Translate, Predict and Generate response button as shown in the above.

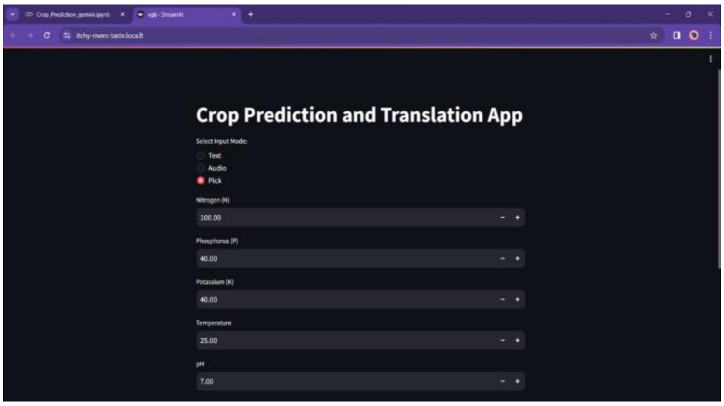

Fig. 5.4: Result 4

The above Fig. 5.4 is for the selection of another type of input mode called Pick. The different values for each type can be increased or decreased. After that, a specific language can be selected.

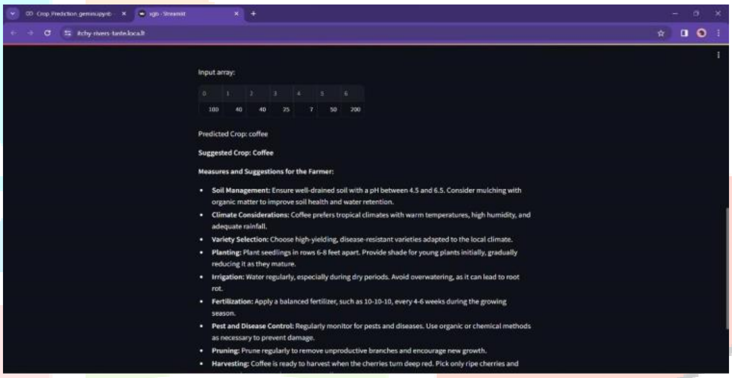

Fig. 5.5: Result 5

The above Fig. 5.5 displays the details of the values that are provided as input in the Pick input mode. For the prediction of the crop, the predict button is chosen so that the suggestion of crops can be given.

VI. CONCLUSION AND FUTURE SCOPE

Conclusion:

In conclusion, the development of the crop prediction and translation web application represents a significant step towards empowering farmers and agricultural stakeholders with data-driven insights, expert recommendations, and real-time predictions. By using machine learning models, natural language processing techniques, and translation capabilities, the application addresses the challenges faced by farmers in crop selection, cultivation practices, and decision-making processes. Through an intuitive user interface and multilingual support, the application facilitates smooth interaction and accessibility for users from diverse linguistic backgrounds and technological proficiency levels. The integration of predictive modeling and expert advice generation enables users to make informed decisions about crop cultivation, optimize agricultural practices, and increase productivity and sustainability in farming. Moving forward, the project holds several opportunities for future improvemnents and expansions.

Future Scope:

Future iterations of the application aim to integrate additional features such as pest and disease prediction, market analysis, and climate change adaptation strategies. Enhanced language support will be implemented to cater to a broader audience, while collaboration with agricultural experts will refine predictive models and recommendations. The development of a mobile application version will improve accessibility, and the platform will evolve into a community-driven hub for knowledge sharing. Integration with IoT devices will enable real-time monitoring for precision agriculture practices.

Acknowledgment

We express our deep gratitude to ourproject guide, Dr. K. Swapna, Assistant Professor(Ad-Hoc), for her guidance and counsel throughout the project. We also thank Prof. Kunjam Nageswara Rao, Head of the Department of Information Technology and Computer Applications, and Prof. D. Lalitha Bhaskari, Chairman, Board of Studies, Computer Science and Systems Engineering, fortheir interest and support in providing necessary facilities for the project. Lastly, we extend our sincere thanks to the academic teaching staff and non-teaching staff for their help throughout their study.

References

[1] "Research on Optimization Techniques Applied to Precision Agricultural Processes" by Jose A. Brenes and Gabriela Marin Raventos. -DOI: 10.1109/CLEI52000.2020.00060, ©2020 IEEE

[2]"Crop Recommendation System Using Machine Learning" by Singana Bhargavi, and Dr. Shrinivasan DOI: 10.17577/NCRTCA-PID-443, ©2023 IJERT

[3] "Optimization Model of Agriculture Product Logistics Network Based on Internet Technology" by Lili Tian. DOI: 10.1109/IPEC54454.2022.9777603, ©2022 IEEE

[4] "Precision Agriculture and Machine Learning" by Anjali Singh, Neha Janu, Sainyali Trivedi, and Mudeet Jain. 978-1-6654-7988-2/22/$31.00, ©2022 IEEE 659| DOI: 10.1109/aic.2022.110

[5] "Optimizing Crop Yield in Agriculture using Data Mining and Machine Learning Techniques" by Dr. Reshmi Welekar, and Dr. Charanjeet Dadiyala(DOI 979-8-3503-3575-0/23/$31.00), ©2023 IEEE

[6] "An agricultural resources optimization model" by Akhil Varma, Ajith S. Nath, and V Regikumar (DOI 10.1109/INDCON.2012.6420815), ©2012 IEEE

[7] "Crop Planning Optimization Research: A Detailed Investigation" by A. Saranya and T.AmudhaDOI: 10.1109/ICACA.2016.7887951, ©2023 IEEE

[8] "Optimized High Performance Deep Neural Network for Crop Recommendation" by Vinay Gautam, Naresh Kumar Trivedi, Abhineet Anand, and Ajay Kumar. -DOI: 10.23919/INDIACom54597.2022.9763156, ©2022 IEEE

[9] "Development of High-Quality Crops Using an Optimized Machine Learning Agriculture Environment" by G. Venkatakotireddy, C. Lakshminatha Reddy, Ramyadevi. R., J. Prabhakaran, T. Nivethitha, Mahaveerakannan R., DOI: 10.1109/ICAIS56108.2023.10073727, ©2023 IEEE

[10] "The Application of Machine Learning and IoT in Smart Agriculture" by Feng Liu andXiaolu Yan.DOI: 10.1109/GCRAIT55928.2022.00019, ©2022 IEEE

[11] "Artificial Intelligence Technology in the Agricultural Sector: A Systematic Literature Review" by Ersin Elbasi, Nour Mostafa, Zakwan AlArnaout, Aymen I. Zreikat, Elda Cina, Greeshma Varghese, Ahmed Shdefat and Ahmet E. Topcu.DOI: 10.1109/ACCESS.2022.3232485, ©2022 IEEE

[12] "Agricultural Crop Recommendation System" by D. Balakrishna, Anumula Praneeth Kumar, Kristipati Sai Kiran Reddy, R. Ravindra Kumar, K.Aadith, andSudarsi Madhan. DOI: 10.1109/CONIT59222.2023.10205756, ©2023 IEEE

[13] "Crop Prediction using Machine Learning Approaches" by Mahendra N, Dhanush Vishwakarma, Nischitha K, Ashwini, andManjuraju M. R., DOI: 10.17577/IJERTV9IS080029, ©2020 IJERT

[14] "A Review of Using Artificial Intelligence and Machine Learning in the Food and Agriculture Industry" by Harikumar Pallathadka, Malik Jawarneh, F. Sammy, Vipul Garchar, Domenic T. Sanchez and Mohd Naved. DOI: 10.1109/ICACITE53722.2022.9823427, ©2022 IEEE

[15] "Machine Learning Applications for Precision Agriculture: A Comprehensive Review" by Abhinav Sharma, Arpit Jain, Prateek Gupta and Vinay Chowdary. DOI: 10.1109/ACCESS.2020.3048415, ©2020 IEEE

[16] "Optimization of Crop Disease Classification Using CNN" by Kit Guan Lim, Chii Soon Huong, Min Keng Tan, Chung Fan Liau, Min Yang, and Kenneth Tze Kin Teo. -DOI: 10.1109/IICAIET51634.2021.9573934, ©2021 IEEE