ISSN 2319-5991 www.ijerst.com

Peer Reviewed, Referred & Indexed Journal

Research Paper

THE ULTIMATE SMART FARMING APP

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ABSTRACT

Agriculture plays a vital role in economic development, and accurate crop prediction is essential for improving productivity and profitability. This project proposes a smart farming application, AgriGenius, which utilizes machine learning and deep learning techniques to recommend suitable crops based on soil nutrients and weather conditions. The system uses algorithms such as Random Forest for crop prediction and Long Short-Term Memory (LSTM) for predicting crop prices and yield trends. The application allows users to input parameters such as Nitrogen, Phosphorus, Potassium, soil type, and weather conditions to receive crop recommendations along with predicted yield and market prices. Additionally, the system provides information about seed purchase locations, helping farmers access required resources بسهولة. The system is implemented using Python, MySQL, and web technologies, enabling real-time interaction through a user-friendly interface. Experimental results demonstrate that the system provides accurate recommendations, helping farmers make informed decisions. This approach improves agricultural productivity, reduces risk, and supports smart farming practices.

Keywords : Smart Farming, Crop Prediction, LSTM, Random Forest, Agriculture AI, Yield Prediction, Price Forecasting, Precision Agriculture

I.INTRODUCTION

Agriculture is one of the most important sectors, especially in developing countries, where it serves as the primary source of livelihood for a large population. Farmers often face challenges in selecting the right crop due to varying soil conditions, unpredictable weather, and fluctuating market prices. Traditional farming decisions are mostly based on experience and intuition, which may not always yield optimal results. This can lead to reduced productivity and financial losses. Therefore, there is a need for intelligent systems that can assist farmers in making data-driven decisions.

With advancements in machine learning and deep learning, it is now possible to analyze

large agricultural datasets and provide accurate predictions. Algorithms such as Random Forest can classify suitable crops based on soil nutrients, while LSTM models are effective in predicting future trends such as crop yield and market prices. These technologies enable farmers to make informed decisions, improving productivity and profitability.

The AgriGenius application integrates multiple functionalities, including crop recommendation, yield prediction, price forecasting, and seed purchase information. The system allows users to input soil and environmental parameters and provides a list of suitable crops along with predicted outcomes. The implementation uses Python for backend processing and MySQL for database management. This application aims to promote smart farming practices by leveraging artificial intelligence, ultimately helping farmers achieve better results with reduced risk.

II SURVEY OF RESEARCH

[1] The study by Leo Breiman (2001) introduced the Random Forest algorithm, an ensemble learning technique that combines multiple decision trees to improve prediction accuracy. The methodology involves random sampling of data and features to construct diverse trees, whose outputs are aggregated to produce final predictions. Results showed that Random Forest performs well on structured datasets and reduces overfitting. However, it may require higher computational resources. In agriculture, this algorithm is widely used for crop recommendation based on soil and environmental conditions. In the proposed system, Random Forest is used to predict suitable crops with high accuracy.

[2] The research by Sepp Hochreiter and Jürgen Schmidhuber (1997) introduced Long Short-Term Memory (LSTM), a deep learning model designed for time-series prediction. The methodology uses memory cells and gating mechanisms to capture long-term dependencies in sequential data. Results demonstrated that LSTM performs well in forecasting applications such as stock prices and agricultural yield prediction. However, it requires large datasets and longer training time. In the proposed system, LSTM is used to predict crop prices and yield trends.

[3] The study by David B. Lobell et al. (2015) explored the use of machine learning for crop yield prediction using environmental and satellite data. The methodology integrates climate variables such as temperature and rainfall with predictive models. Results showed improved accuracy compared to traditional statistical methods. However, the approach depends on data availability. This research highlights the importance of environmental factors in agricultural prediction. In the proposed system, similar parameters are used for crop recommendation and yield estimation.

[4] The research by Tianqi Chen and Carlos Guestrin (2016) introduced XGBoost, an optimized gradient boosting algorithm. The methodology includes regularization, parallel processing, and efficient handling of missing values. Results showed that XGBoost achieves high accuracy in prediction tasks. However, it requires careful tuning of parameters. In agriculture, boosting techniques improve prediction performance. Although not used as the primary model, this research supports the use of advanced algorithms in agricultural applications.

[5] The study by Geoffrey Hinton et al. (2006) introduced deep learning concepts that enable neural networks to learn complex patterns. The methodology involves multiple hidden layers and non-linear transformations. Results demonstrated significant improvements in prediction tasks involving large datasets. However, deep learning models require high computational power. In agriculture, these techniques help in analyzing complex relationships between soil, weather, and crop yield. In the proposed system, LSTM is used as a deep learning model.

[6] The research by Yoshua Bengio et al. (2015) emphasized the importance of deep learning in handling large-scale data and complex relationships. The methodology involves hierarchical feature learning from data. Results showed improved performance in various predictive tasks. However, large datasets are required for effective training. In the proposed system, deep learning techniques are used to enhance prediction accuracy for crop yield and price forecasting.

III. WORKING METHODOLOGY

The proposed AgriGenius system follows a structured pipeline that includes data preprocessing, model training, prediction, and user interaction through a web-based interface. Initially, the dataset containing crop information is loaded into the system. This dataset includes features such as Nitrogen (N), Phosphorus (P), Potassium (K), soil type, weather conditions, and crop yield details. The data is preprocessed by handling missing values, shuffling to remove bias, and applying normalization to scale features into a uniform range. After preprocessing, the dataset is split into training and testing sets, where 80% of the data is used for training and 20% for testing. This ensures that the model is evaluated on unseen data for reliable performance.

In the next phase, machine learning models are trained using the processed dataset. Random Forest is used to classify and recommend suitable crops based on soil nutrients and environmental conditions. At the same time, a Long Short-Term Memory (LSTM) model is implemented to predict crop yield and future

market prices. The models learn patterns and relationships from the training data and are optimized using hyperparameter tuning techniques. The trained models are then tested using the test dataset to evaluate their accuracy and performance. The system calculates prediction accuracy and compares results to ensure reliability.

Finally, the trained models are integrated into a user-friendly web application. Farmers can sign up, log in, and input parameters such as soil nutrients, season, and weather conditions. The system processes these inputs and provides a list of recommended crops along with predicted yield percentages and market prices. Additionally, the application includes a module that displays seed purchase details, helping farmers locate suppliers. The system is implemented using Python for backend processing, MySQL for database management, and web technologies for the interface. This methodology ensures an efficient, scalable, and intelligent solution for smart farming and agricultural decision-making.

IV RESULTS EXPLANATIONS

Computer algorithms are utilizing everywhere to predict future values so in propose work we are applying deep learning LSTM algorithm to predict agriculture crop based on current weather and soil condition. Experienced farmer can input model with Nitrogen, Phosphorus, weather, soil and Potassium to predict suitable crop along with future prices and yield.

Propose application can help user to know about various places which sale different seeds

With software and programming whatever modules possible we have implemented all those modules. To implement this project we have designed following modules

1) New user sign up: user can sign up with the application

2) User Login: user can login to system

3) Load & Process Dataset: using this module will upload and process dataset and then split dataset into train and test where application using 80% dataset for training and 20% for testing

4) Train ML Models: 80% processed data will be input to algorithms to train a model and this model will be applied on 20% test data to calculate prediction accuracy

5) Crop Recommendation: using this module user can input soil details, season and other values to predict suitable crop along with prices

6) Seed Purchase Details: This module will display shop details where he can purchase different seeds

International Journal of Engineering Research and Science & Technology

In above screen selecting and uploading 'crop recommendation' dataset and then click on 'Open and submit' button to get below page

In above screen dataset loaded and can see 80% data is using for training and 20% for testing and now click on 'Train ML algorithms' link to get below page

In above screen can see Random Forest and LSTM accuracy where random forest trained to predict crop and LSTM train to predict price and now click on 'Crop Recommendation' link to get below page

In above screen chose soil and season type and then enter chemical details and then press button to get below page

In above screen we got list of suitable crop along with yield percentage and can see predicted prices. In above screen can see if farmer sow 'Rice' then he will get 73% Rice yield and 27% jute so better to sow rice. Similarly you can select any values and get prediction and below is another sample

In above screen I gave another input and below is the output

In above screen if farmer grow Maize then he will get 99% yield and 0.01% cotton yield so better to sow Maize.

In above screen they can enter 0 for all chemical values if they are inexperienced and can choose only soil and season details and then press button to get below page

In above screen can see list of crops with yield and price for selected soil and season. Now click on 'Seed Purchase Details' link to get below page

In above screen user can see at which place he can purchase what types of seeds.

V. CONCLUSION

The AgriGenius smart farming application provides an effective and intelligent solution for improving agricultural decision-making using machine learning and deep learning techniques. By integrating Random Forest for crop recommendation and LSTM for yield and price prediction, the system delivers accurate and reliable results based on soil nutrients and environmental conditions. The application helps farmers select suitable crops, estimate yield, and understand future market prices, thereby reducing risk and increasing profitability. Additionally, the inclusion of seed purchase information enhances practical usability. The system's user-friendly interface and real-time prediction capability make it scalable for real-world agricultural applications. Overall, AgriGenius promotes data-driven farming practices, improving productivity and supporting sustainable agriculture.

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