Agrigenius: The Ultimate Smart Farming App

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ABSTRACT— Agriculture remains one of the most important industries in the world. Hence, the incorporation of technological advancements and intelligent decision support systems plays a critical role in enhancing efficiency in the industry. Conventional farming largely depends on personal experience by the farmer, unreliable environmental factors, and other variables leading to poor crop yields, mismanagement of resources, and wrong crop choice. However, in our application Agri-Genius, we present an innovative and predictable farming assistance system that uses deep learning algorithms to help farmers decide on the most efficient crops based on available soil nutrients, weather conditions, and seasons using Long Short-Term Memory (LSTM) and Random Forest.

The proposed system offers ease of use as new users can register to access the various sections including dataset loading, model training, crop recommendation, and even purchase of seedlings. New users who do not know specific chemicals can have some defaults predicted by the system based on the input parameters and other environmental factors. The system uses LSTM to capture temporal patterns from agricultural datasets to predict prices of crops, whereas random forest helps classify the most possible crops using the given parameter. Furthermore, Agri Genius also incorporates real-time mapping of seedling purchase locations hence offering easy access to reliable seedling suppliers. Agri Genius is implemented using a web-based interface using Python 3.7.2 and MySQL.

INTRODUCTION

The only method by which foods could be created other than agriculture is unavailable. Traditional agriculture would be the most effective way of producing healthy and efficient foods through seasonal agriculture by Ancestral Farmers. But due to change in environment and climatic conditions like global warming, this kind of agriculture could not possibly take place now, hence making this a challenging process in performing traditional agriculture. With decreasing agricultural methods, availability of nutritious foods has also turned into a difficult situation to cope with. For achieving quality production and to overcome challenges associated with agriculture, smart farming could become an answer.

Smart farming refers to the use of technology for agriculture. Many kinds of technologies have been introduced in the agricultural field, but these methods of agriculture are not based on any traditional process. One more difficulty with these practices is that constant use of technology makes farming even more problematic. Improper and inappropriate farming procedures are performed with the help of technology leading to waste of crops and produce from them.

PROBLEM DEFINITION

The agriculture sector still depends a lot on conventional farming practices, which require human expertise, weather predictions, and variable environmental conditions. Conventional farming techniques have led to poor results due to wrong crops being chosen, inefficiency in terms of low yield, and wastage of water, fertilizer, and seeds. Conventional agricultural systems are not capable of providing any data-based analysis or predictions in terms of expected crops and prices.

Thus, there is a necessity for an intelligent agricultural system that can help in predicting the crop choices, yield expectations, and price forecasts. Hence, the Agri Genius system will be used to make use of data to suggest effective measures for farmers based on the application of various machine learning algorithms, such as Random Forest and LSTM.

1.2 PROJECT FEATURES

Develop an intelligent agricultural advisor system which will recommend farmers about crop selection through the use of information about soil nutrition, weather, and season. Implement sophisticated machine learning techniques like LSTM and Random Forests for the recommendation of crops, yield prediction, and crop price predictions. Offer predictive analysis that will guide farmers in making informed decisions to boost production and avoid any kind of risks and wastage. Create a simple-to-use web portal where users will be able to register, manage datasets, train the machine learning model, and predict the crop without any technical skills. Make predictions about future crop prices using the temporal data modelling technique of LSTM.

Related Work

A number of research studies have been conducted in the field of smart agriculture and precision farming with the use of technologies such as IoT, wireless sensor networks, and machine learning. The previous researches were based on the management of uncertainties in agriculture through various modeling approaches. The significance of data-driven models in improving the productivity and efficiency of crops was emphasized by these researches. The concept of wireless sensor networks incorporated the use of sensors for monitoring environmental parameters such as humidity, temperature, and soil moisture for effective management of farming activities. Further researches were carried out on the design of frameworks for environmental monitoring through wireless sensors. Methods for measuring soil moisture content and classifying the soil with the help of smartphone-based sensors were also suggested in these researches.

METHODOLOGY

Ultimate Smart Farming App works on making intelligent recommendation of crops and price prediction of crops using techniques of Machine Learning and Deep Learning. Methodology.

Step 1: Data Collection

Firstly, the Agricultural Datasets must be collected which includes Nutrients in Soil (Nitrogen, Phosphorus, Potassium)

Type of soil Seasonal information Crop name Historical crop price Data Collection is done by reading .CSV file format.

Step 2: Data Preprocessing

Collected Data is pre-processed before training.

Steps involved in Data Preprocessing are Handling missing values Removing null values Categorical Encoding Normalization of numerical values 80:20 split.

Step 3: Crop Recommendation using Random Forest
Recommendation of Best Crop is performed using the Random Forest Algorithm. Steps Involved in Random Forest
Input Values
N
P
K
Soil Type Season Decision Tree Formation Crop Recommendation based on probability.

Step 4: Crop Price Prediction using LSTM
Future Price of recommended crop can be predicted using the Long Short-Term Memory model (LSTM). Steps Involved in LSTM Using Historical Dataset of Crop Price Learning time series Future market price prediction It helps in knowing the right time to sell the crops. LSTM is useful due to changes in crop price.

Step 5: Model Training and Evaluation
Training of the above two Models is done using processed datasets.
Random Forest – Used to predict crops
LSTM - Used to Forecast Crop Prices
Training is done using following parameters Accuracy Confusion matrix R^2 Score Graphs.

Step 6: Result generation
Results are generated after the entry of soil and seasonal information by users. Recommendation of crops Expected yield percentage Prediction of Future Market Price of Crops
Seed Availability Details.

Step 7: Final Output

Recommended Crop

Percentage Yield

Future Crop Price

PROPOSED SYSTEM

I. Proposed System

The suggested Agri Genius system makes use of the algorithms of LSTM and Random Forest for giving crop recommendations, predicting future prices of crops, and advising on where to buy seeds.
Merits:
1. Utilizes machine learning algorithms such as Random Forest and LSTM for predicting accurately.
2. Provides predictions regarding price per crop, yield percentage, and crop recommendations.
3. Recommends locations from where seeds can be purchased by users.

IMPLEMENTATION DETAILS

Project implementation is the stage where the planned strategies and activities of the project are carried out. Careful planning and coordination will help to ensure the success of this stage since proper implementation is important for realizing the objectives of the project.

4.1 ALGORITHMS USED

4.1.1 Random Forest Algorithm

Random Forest algorithm is a machine learning technique in which decision trees are used in combination to increase accuracy and reduce errors in prediction. It builds several models and combines the output from all these models to give an output.

In the field of intrusion detection systems in IoT, it acts as a classifier model to detect if the traffic is an attack or not. It has strong features of robustness and dealing with vast amounts of data. In order to prevent error and enhance generality, Random Forest algorithm uses more than one decision tree in its operations.

Advantages:

High accuracy: Gives reliable output because of multiple models involved.

Robust in nature: Can handle data in presence of errors and missing values. Less chances of overfitting: As compared to decision trees individually.

Disadvantages:

Interpretability is poor: Not easily interpretable as compared to other simple models.

Increased memory requirement: Due to multiple trees

4.1.2. Long Short-Term Memory (LSTM)

LSTM algorithm is a special form of Recurrent Neural Network (RNN). LSTM remembers long-term dependencies, and thus, it is useful in analyzing changes over a period of time in the pattern of data.

LSTM allows us to find patterns in traffic flow. As there is an occurrence of time-related attacks in IoT systems, LSTM performs much better as compared to others.

Advantages:

Capable of capturing temporal pattern: Best choice for IoT data. Accurate in predictions: Excellent for sequence prediction tasks.

Disadvantages:

-Uncomplicated algorithm: Hard to implement and costly.

EXPERIMENTAL RESULTS AND DISCUSSION

The following screens illustrate some of the outcomes of our project, indicating some important functionalities of the system. These images clearly show how effectively our project works when tested under certain circumstances. System Interface – Home Page:

Figure 5.1: GUI/Main interface of Agri Genius application indicating modules such as dataset loading, training, and crop prediction

Below screenshot demonstrates the selection of the soil and season types and input of chemical data. Then click on the button to get the screen shown below.

Figure 5.2: Screen to input soil and environmental parameter values for crop prediction. Below screen demonstrates the selection and upload of “AgriGenius application” dataset. Then click on the button named 'Open' to load the dataset.

Figure 5.3: Module for loading the dataset and splitting it into training and testing sets.Below screen demonstrates loading the selected dataset and shows that 80% of the dataset is used for training, while the remaining 20% is used for testing. Then click on the button "Train ML algorithms".

Figure 5.4: Above screen indicates loading the selected dataset, where 80% of the data is used for training purposes and 20% of the data is used for testing purposes.

Below screen shows the evaluation metrics of Random Forest model predicting the crop.

Figure 5.5: Evaluation metrics of Random Forest and LSTM models for crop and price predictions, respectively. Above screenshot displays the accuracy of the Random Forest and LSTM models, where the Random Forest model was trained to predict crops, whereas the LSTM model predicted prices. Then click on the 'Crop Recommendation' link to get the screen shown below:

Figure 5.6: Evaluation metrics and graphical results of the LSTM model for crop price prediction.

CONCLUSION

The Agri Genius: The Ultimate Smart Farming App provides an outstanding illustration of the potential of artificial intelligence and machine learning technologies to innovate the field of traditional agriculture through data-driven predictive decisions. Using LSTM and Random Forest, the system offers farmers recommendations about what to plant considering factors such as the soil type, climate, seasonality, and other related factors. Furthermore, the application helps forecast future prices for the recommended crops and their percentage yield. With a friendly user interface that

is accessible through any computer with Internet access, the application makes use of its modules, namely the processing of the dataset, training, prediction of crop prices, and seed purchase location maps, to provide farmers with comprehensive information regarding agricultural practices. Consequently, the application contributes to increasing profits, decreasing waste of resources, increasing productivity, and making farming sustainable.

FUTURE SCOPE

Future Improvements of Agri Genius:

1. Utilization of IoT Sensors: The next iteration of this program can feature IoT-based sensors for gathering information about the state of soil and weather and improve the precision of crops and yield predictions.

2. Creating Mobile App: Developing Agri-Genius as an Android and iOS application will help it reach rural farmers who do not have access to computers.

3. Incorporating Satellite or Drone Imagery: The program can incorporate satellite images or drone footage to monitor the condition of crops and identify problems such as disease at earlier stages.

4. Seed Purchase Transparency Using Blockchain: With the implementation of blockchain technology, this application will be able to prevent counterfeiting seeds during their delivery process.

5. Voice and Multilingual Options: In order to make the program more inclusive and convenient for farmers who speak other languages, it is possible to introduce voice assistance and translation features.

6. Connecting to Markets and Profits Forecast: As an addition, it can gather data on current markets where farmers can sell their products and predict profits for their farms.

7. Sustainability and Adaptability of Farming Practices: Finally, Agri Genius can integrate long-term climatic patterns and suggest more sustainable agricultural practices based on them.

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