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Farming Tool Leverage System and Expert Chat

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***Abstract*— The average annual income of farmers in India is well below the poverty line, primarily due to off-season agriculture and a lack of awareness about optimal farming techniques and crop management. This research paper presents an AI-based web application designed to address these challenges and improve farmers' financial and mental well-being. Our solution, comprised of a farming tools leverage system and a collaborative farming forum, empowers farmers with the knowledge and tools needed to make informed decisions and increase their income. The system leverages MongoDB, asynchronous calling, and Fast API for efficient data management and real-time interactions. AI/ML services assist with crop recommendations, crop disease detection, and price predictions. Load balancing ensures optimal performance, and Pusher JS enables real-time communication. Billing services and a dashboard provide income insights, while geographic data enhances machine learning recommendations.**
In conclusion, this research contributes to alleviating poverty and enhancing the livelihoods of farmers in India by providing a comprehensive solution to the challenges they face.

***Index Terms*— Machine learning models, leverage system, expert chat, Trending crops, widget, Tool price prediction, Crop disease detection.**

I. INTRODUCTION

Food security and sustainable development depend heavily on the agricultural industry, so it is crucial to assist and equip farmers with the right equipment, supplies, and professional guidance. Agriculture has not been exempt from the changes brought about by artificial intelligence (AI) in recent years.

This study intends to showcase an AI-based web application created to offer farmers a comprehensive platform where they can access tools, resources, and mentors' professional guidance. The key features of our proposed solution include:

Farming Tools Leverage System: This system assists farmers in various tasks such as crop management, irrigation, pest control, and harvesting. It offers real-time support through a forum for query resolution, a marketplace for renting and purchasing equipment, and an AI-powered chat bot for common issues. Additionally, it provides insights into crop trends and predicts selling prices for both new and used products.

Collaborative Farming Forum: A platform designed for farmers and enthusiasts to exchange knowledge, ask questions, and discuss farming-related topics. Users can create posts, comment on posts, and share valuable resources such as articles and videos.

AI and ML will be used to suggest Farmers which tools be best to rent according to climate, location, crop & purchasing power. It will be used to provide Real time interaction with Farmer. Predict pricing of tools to provide best possible rates for both parties based on time period, demand, profits and type of farming. The System provides

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Question & Answer platform to get solutions to farmer's query, different sales and rent stores to leverage unused products, FAQ chat bot for simple issues, Crop trend section for knowing demand and supply of crops, Selling Price prediction for used/new products.

II. Literature Review

In [1], the authors have built a deep-learning model for crop disease detection. Analyzing pictures of leafs and then properties to classify them as disease but no mentorship is given and used just for detection purposes.
In [2], the authors have proposed a Farming Guru app with weather prediction, crop analysis, farm equipment rental service to earn additional income for farmers. Limitations involve the lack of a crop disease detection service and the option of buying or selling farming equipment. This project has overcome this limitation by providing crop disease detection, market demand for crops, and the buying and selling of farming equipment.
In [3], the authors have used the spatial-temporal clustering model clusters farmlands with the same time window and working requirements and optimizes the intra-cluster routes. The limitations include the need to consider uncertainties during the working process. This project solved this problem by considering weather conditions.
In [4], the authors have used mobile application that the farmers can use to hire tractors as well as other mechanizations at a nominal amount. This paper doesn't focus on the recommendation of the crop and doesn't provide services such as crop disease detection and mentor advice.
In [5], the authors have provided a prediction on soil requirements to increase productivity and gain profit from such a technique. Limitations include that model learning depends only on soil conditions. This project solved this problem by using other factors to train the model.
In [6], the authors have built a web-based application for farmers to rent equipment for agriculture. The farmers are provisioned to list their equipment's on the website and other farmers can pay to rent-out the equipment's they need. Website for farming tool renting purpose No scope for crop disease detection or expert advice
In [7], the authors have developed a system that tells the farmers the type of crop disease from an image and instantly give a solution for the same. The limitations found is mentor advice is not provided. This project solved the above limitation by providing service of mentor advice
In [8], the authors have proposed a Farm Log Rental Service Platform Agri-Brilliance with Farm Equipment Rental Service, Crop Prediction, Plant Disease Prediction and view soil testing centers. Limitations involve the lack of the option of buying and selling farming equipment through the platform alongside the rental service of farming equipment.
The authors of this research [9] have suggested machine learning-based crop recommendation system strategies. They used machine learning algorithms which includes KNN, Decision Tree, and Random Forest. Limitations involve the lack of the option of buying and selling farming equipment, crop disease detection, expert advice, social forum.
The authors of this study [10], concentrated on deep learning methods for image-based plant disease identification. Limitations include the absence of the ability to buy and sell farming equipment, a crop recommendation system, a resale check value, expert guidance, a social forum, and a service that displays the most popular crops at the moment.
In [11], the author addressed the complexity of agriculture due to extensive data and variables. They explored using artificial neural networks (ANNs) to predict crop production, considering multiple indicators. The challenge lies in the complexity of the agricultural system, impacting crop yield. Our project addresses this by applying non-linear methods like random forests to improve crop yield prediction.
The author of this study [12] provides a thorough literature review on the use of artificial intelligence methods in agriculture. Agriculture diseases cause significant crop losses and environmental risks as a result of the overuse of chemicals. Hybrid systems, like neuro-fuzzy or image processing combined with artificial neural networks, are being used today. It progresses towards more accurate, automated, and real-time systems.
Described in [13] Disease outbreaks pose a persistent threat to agriculture and substantially harm the national economy. Early detection can therefore lessen the severity of illnesses and safeguard crops.
The purpose of this effort [14], according to the paper's author, is to create a software system that can mechanically locate and categorize diseases. Images of the leaves are used to identify plant illnesses. One of the paper's limitations is that it only examines specific diseases only.
In [15], the author focuses on a method for identifying plant diseases that uses image processing and machine learning. In this paper, they suggested an Android app that aids farmers in spotting plant diseases by submitting a photo of a leaf to the database. Authors inferred from the statistics above that convolutional neural networks (CNN) offer a remarkable degree of accuracy in identifying diseases.

III. PROPOSED WORK

A Farming tools leverage system is a software solution that aims to make the process of farming more efficient by leveraging technology. The system can be designed to help farmers in various tasks, such as crop management, irrigation, pest control, and harvesting.
A Forum for farming is a platform designed for farmers and farming enthusiasts to share knowledge, ask questions, and discuss farming-related topics. The platform can be designed to allow users to create posts, comment on posts, and share resources such as articles and videos.
This project also provide an admin panel to list products as from a single source of truth. The website also provides features such as Crop recommendation based on current soil stats, rain, temperature and other farmland specs . With Crop disease detection which suggests disease with other useful information when a user uploads a picture of crop.
The detailed workflow for the proposed system is delineated below:

- The solution mainly starts from registration and login with use of MongoDB Database to handle queries related to forum and order placed for rent and purchase.
- Farmers can use forum to get their queries resolved by expert and fellow farmers. Features such as share and comments can be utilized.
- Farmers can utilize Marketplace for renting and purchasing equipments. User can use billing service powered by Razor Pay to purchase and rent the items.
- This project utilized AI/ML services to accurately provide crop produce recommendation, crop disease detection by monitoring images and query resolution in real time .This project utilized FastApi server to optimize Machine Learning tasks.
- This project studied data for Used and new farmer tools to predict about the probable price for an equipment.
- Farmer can utilize trained FAQ bot to get normal queries resolved. This project provided solution to farmers , where they can analyze current demand and supply ratio for crops , such that they don't grow crops with less profit margin , refer Fig 3.1

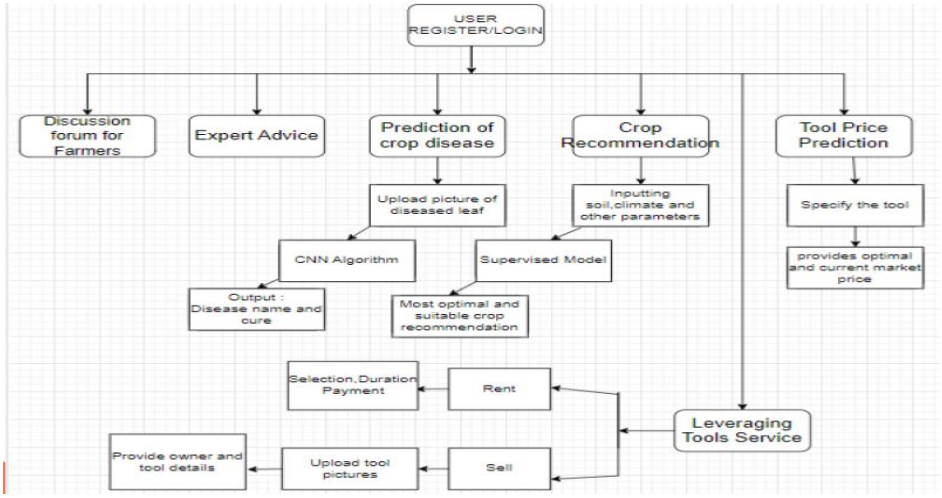

Fig. 3.1 Workflow of System

The Architecture Design of software system can be described as,

- The clients access the proposed system; the client requests go through a load balancer first.
- The Load balancer basically manages api calls and services to maintain balance between each service being used. Load balancer is used to avoid performance bottlenecks and to create a distributed architecture.
- The clients can post questions or queries in the forum and access previously answered queries for more information, fetched from the Database.
- Pusher JS is like a web socket which maintains real time interaction between services. Pusher JS is used for maintaining a synchronous connection to allow servers to push new data to clients instantly.
- Billing service and Dashboard are for reporting service to clients to check income generated and other details.

- Products can be searched or chosen by clients through a list of products fetched from the Database for leverage of farming equipment. Geographic details such as soil and climate information are used for training the Machine Learning Service.
- The Machine Learning Service is used for making product recommendations based on the crop details and crop recommendations based on geographic details provided by the clients.
- The Pricing Service is used to predict and suggest an appropriate price for the product recommended by the Machine Learning Service.
- The Database stores previously posted questions and queries of the clients and the list of products and their corresponding relevant details. The Database also includes Crop details for recommending Crops based on the Client's requirements as shown in Fig 3.2.

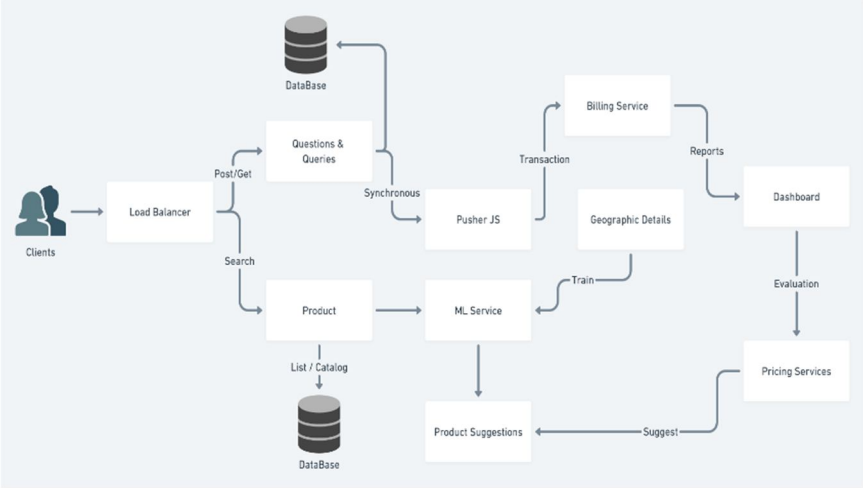

Fig. 3.2 Architecture Design Model

Implementation Details of Leverage system is as follows,
Algorithm 3.1 begins with pre-processing of dataset by normalizing the price field to gain more insight values, next split dataset into test and train sets, and feed into Random Forest Regressor. Performed testing and observations and saved model for future use in pickle.
Algorithm 3.1: Used Price Prediction of farming equipment
Input:
• Majority training Data
• Normalized Price Data
Output: Predicted Price, Ptool.

- Pre-process Dataset to obtain final Dataset & Split into train and Test tests
- Load Normalized data into Random Forest Regressor & dump trained model into pickle file for loading into server
- To Predict tool price

Algorithm 3.2 begins loading of Image Dataset, applying image processing techniques to normalize the dataset , and applying CNN model to classify images . Then testing and observations using Torch.
Algorithm 3.2: Farmer's provided crop image disease detection
Input:
• Majority training Image Data
Output: Classified diseases and supporting Information, image.

1. Normalize Image Dataset to obtain final Dataset
2. Transform Images into enhanced version by using Image processing techniques
3. Load Normalized data into CNN module and also perform more computation
4. Perform batch training for some epochs & Predict Disease information and supplements etc.

Algorithm 3.3 begins by analyzing customer care call records and analyzing them. Next build intents from them and feed into chatbot.
Algorithm 3.3: Farmer's query Resolution chat Bot
Input:

Question and Answers customer care data

Output: Probable Answer to Query, Answer Query.

1. Preprocess queries and call records of Customer care & process query answers into Intents using DialogFlow
2. Train chatbot & receive answers to normal query

Algorithm 3.4 begins with processing Dataset and normalizing temperature, soil and rainfall values .Next this project applies some techniques such as Decision tree, Bayes algorithm, Random Forest, SVM etc. and train model.
Algorithm 3.4: Based on farmer input, recommend profitable crop choice to grow Input:

- Major dataset, with classes

Output: Recommend Choices of crop, C1, C2, C3.

1. Preprocess dataset with crops and other parameters
2. Split into train and test classes
3. Train model with ensembling technique with supporting algorithms such as Naive Baye's , SVM , Decision Tree and Random Forest
4. Metrics and load into pickle

Details about working web application can be described as,

1. Question Answer Portal and Discussion

This Feature provides a space where the user can post his query with a picture to get better results and solutions from Farm experts and fellow farmers. This feature is intended to provide much needed guidance to farmers. A farmer can put their advice and solutions into the Solutions tab provided. He can share the question and solution via external share such as twitter or whatsApp.

2. Sales and Rent stores

This feature is intended to solve the no-income state of farmers in off-season, and make them independent from one source of income. This helps farmers by making them leverage their systems / tools in off-season thereby providing an extra source of income to them.
Similarly users of these products get to use tools which they can't afford at lower prices and improve productivity of their farm.

3. FAQ Chatbot

In the website users can use a floating action button or separate section to interact with this. This basically provides simple and fast resolutions to general queries of farmers. The chatbot has been trained on a dataset provided by the Government of India, which consists of interactions between Krisihi Sahyog expert and farmer. This is implemented by converting interactions into Intents and with use of DialogFlow.

4. Recommendation to grow Crops

This project provides this feature, by using which farmer by providing various major factors of his geological location such as Minerals contents of soil, moisture, temperature etc., can know the best crop to grow to yield maximum returns and a good quality product after harvest. Built using ML models such as Naive Bayes, SVM and Random Forest and FastApi as backend server handling running of Model and providing data to React.

5. Selling Price Prediction

Using this tool, a farmer, by letting us know the condition of his tool which he wants to list on the website for sale / rent, can estimate its final selling and rent price on the go. The parameters involve details such as Manufacture year, Manufacturing company, Modal number, used days, working Condition etc.

6. Trending Crops

This feature is intended to provide approximate insight to farmers about demand and supply based on Government Data. This is intended to tell farmers which crops will be more profitable for them to grow and thereby reduce instances of wasting crops and milk etc. by farmers in protests.

7. Crop Disease Detection

To use this feature shown in farmers upload their crop pictures and using CNN with a gradient model and a dataset of 54,000 images this project tries to detect the disease for the crop. This project also provide details such as explanations about disease, supplements to cure these diseases, the experts suggestions and suggested product image and buy link.

IV. Results And Discussions

The solution is able to provide a different way and one stop solution to farmers to earn extra side income and tools to help their everyday work and make it easy. This project used MERN stack to develop core architecture of web application and utilized FastAPI as AI/ML Backend server with python . Majorly this project used Convolutional Neural Network to analyze large datasets of disease crop images and to build models which can provide accuracy of 98 percent as in Table 4.1 .To use this feature , farmers upload their crop pictures and using CNN with a gradient. model and a dataset of 54,000 images , this project try to detect the disease for the crop .This project also provide details such as explanations about disease , supplements to cure these diseases , the experts suggestions and suggested product image and buy link .

Table IV.1: Accuracy For Crop Disease Detection

Method	Accuracy
CNN	98 %

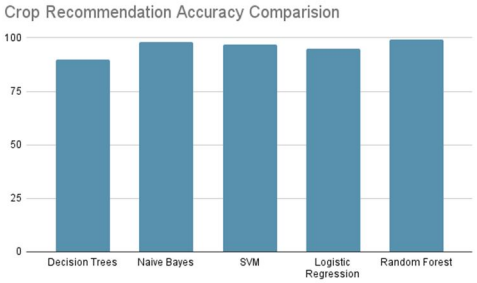

Figure 4.1: Crop grow Recommendation Plot

For Crop recommendation, this project implied Decision tree, Gaussian Naive Bayes , SVM ,Logistic Regression and Random Forest . Applied Random forest to achieve Accuracy of 99.09 percent , refer Table 4.2 . Provided this feature, by using which farmer by providing various major factors of his geological location such as Minerals contents of soil , moisture , temperature etc. , can know the best crop to grow to yield maximum returns .This project applied algorithms such as Linear Regression , SVM , Naive Bayes and Random Forest to predict resale value and optimal price for tools . Due to lack of dataset availability , built over own dataset ,refer Table 4.3 To use this tool , a farmer, by letting us know the condition of his tool which he wants to list on the website for sale / rent , can estimate its final selling and rent price on the go, refer Fig 4.1 & 4.2

Table IV.2: Accuracy For Crop Recommendation System

Method	Accuracy
Decision tree	90 %
Gaussian Naive Bayes	98.04 %
Support Vector Machine	97.75 %
Logistic Regression	95.2 %
Random Forest	99.02 %

Table 4.3: Accuracy For Prediction

Method	Accuracy
Linear Regression	52.08 %
Support Vector Machine	54.257 %
Naive Bayes	57.445 %
Random Forest	65.564 %

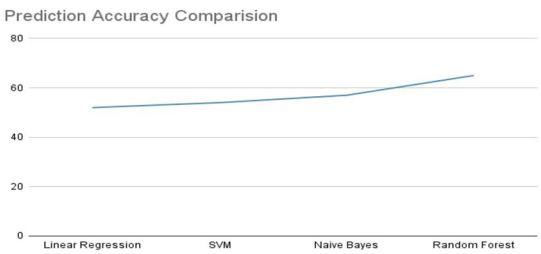

Figure 4.2: Tool price Prediction Plot

V. Conclusion And Future Work

The AI-based web application provides a variety of services to help farmers in India overcome the obstacles they confront in order to enhance their income and quality of life. A question and answer portal, rental and sales locations for farming equipment, a chatbot for frequently asked questions, data on popular crops, suggestions for optimum crop growth, selling price forecasts, crop disease detection, news updates, and an admin panel are among the services offered. By providing these services, the proposed application aims to give farmers the tools, resources, and professional guidance they need to enhance their farming methods, boost crop yields, and eventually enhance their financial well-being. By providing creative AI-based solutions to the issues encountered by farmers in India, the programme has the potential to revolutionize the sector.

There are few potential future scope areas for this Farming tool levarage system Integration with precision agriculture technologies, such as GPS mapping and soil sensors, to provide more accurate and data-driven insights for farmers. Development of a mobile application version of the farming tool leverage system to enable farmers to manage their operations from anywhere. Incorporation of weather forecasting technology to provide real-time insights on weather patterns and help farmers plan their operations accordingly.

Compliance With Ethical Standards

The authors declare that there is no competing interest or conflict of interest in this paper

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