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"GREEN THUMB" – SMART AI ASSISTANT FOR CROP RECOMMENDATION AND PLANT CARE

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Abstract: With the growing need for better farming and gardening practices, agriculture and gardening depend more on smart and informed decisions. But many farmers and gardeners still depend on traditional methods, which do not always give accurate results. Because of this, it can lead to reduced productivity and sometimes poor plant growth. This paper presents the design and development of GreenThumb, a system that helps users to make better decisions in crop selection and plant care. It is a web-based platform that uses open-source Artificial Intelligence to give crop recommendations based on soil type and weather conditions. Along with this, it also helps users identify plant problems using symptom-based inputs and suggests possible solutions. A basic evaluation of the system shows that it is easy to use and gives useful suggestions for daily gardening needs. The overall approach mainly focuses on making technology simple and accessible, especially for people who have less technical knowledge, and it also promotes better and more sustainable farming practices.

Keywords: Artificial Intelligence, Crop Recommendation, Machine Learning, Smart Agriculture, Soil Analysis, Precision Farming, Plant Care.

I. INTRODUCTION

A. Background

Agriculture and small-scale gardening play a very important role in supporting food production and sustainable living. But it is not always easy to take right decision about crop selection and plant care, especially for people who don't have much technical knowledge or proper guidance from experts. Factors like soil condition, seasonal changes and plant health greatly affect the crop productivity, but understanding all these factors usually require experience and right information at right time. With the advancement of technology, artificial intelligence has become a useful tool for helping in decision making in different fields, including agriculture. AI-based systems can analyse user inputs and give helpful suggestions in a simple and easy way.[1] This creates an opportunity to develop smart solutions that can guide users in improving crop yield and maintain plant health without needing deep knowledge or expertise.

B. Problem Statement

Despite the availability of agricultural knowledge, many farmers and home gardeners still face difficulties in selecting suitable crops and identifying plant-related problems at the right time. Traditional method often depends on guess work or delayed expert consultation, which can lead to poor crop yield, plant damage and also increased costs. In addition, existing solutions are often complex, expensive, or not easily accessible for beginners. There is lack of simple and user-friendly systems which can provide quick and reliable guidance based on basic observations. Because of this, users are not able to take proper decisions regarding soil suitability, crop selection and plant health management.

C. Objective of the Study

The main objective of this study is to develop a web-based system, GreenThumb – Smart AI Assistant for Crop Recommendation and Plant Care, which helps users in making better agricultural decisions through a simple and interactive platform. The system aims to recommend suitable crops based on soil type and seasonal conditions, and also help users to identify plant problems using visible symptoms. By giving easy-to-understand suggestions and guidance, the system tries to improve productivity and reduce losses. The novelty of the system is that it combines crop recommendation and plant disease diagnosis in one web-based platform. Unlike other solutions that use complex models or image recognition, it uses a simple symptom-based approach, so home gardeners and small-scale farmers can use it easily.[2][3]

II. RELATED WORK

Artificial Intelligence has gained a lot of attention in agriculture in the past few years, especially for improvement in crop management and detecting plant disease. Many studies have explored this area. For example, Mohanty et al. (2016) used deep learning techniques to identify plant diseases with higher accuracy. In a similar way, Ferentinos (2018) worked on models that can diagnose diseases across different types of plants.[4] Barbedo (2013) showed that image processing techniques can also play an important role in detecting plant health issues. It was also discussed by Kamilaris and Prenafeta-Boldú that AI can be used more widely in agriculture, like in yield prediction and farm monitoring, which is becoming more useful nowadays. Even though these methods are effective, advanced knowledge or technical resources are required by them.[5][6] Because of this, it is not always practical for everyday users like small-scale farmers or home gardeners, and it becomes difficult for them to use it properly. So, there is need of simpler systems which are easy to use and understand.

Ghadge et al. [28] propose a theoretical framework for crop recommendation. Kulkarni et al. [29] focus on enhancing crop productivity by developing a crop recommendation system based on ensemble techniques. Pudumalar et al. [7], whose work is among the most cited on IEEE Xplore, present a comparable machine learning-based approach using data collected from a district in Tamil Nadu, India; however, their study does not report model accuracy or provide sufficient details about the dataset used. In addition, a well-known review titled *"Machine Learning in Agriculture"* by Konstantinos G. Liakos et al .[8] discusses a wide range of machine learning applications in agriculture but does not specifically address crop recommendation.

Some related studies in agriculture are only indirectly connected to crop recommendation. For instance, Ayaz Muhammad et al. [9][10] primarily examines the use of the Internet of Things (IoT) and sensor technologies for agricultural data collection. Other research in this domain focuses on crop yield prediction rather than recommendation. Overall, our survey indicates that research on crop recommendation remains limited, with most of the existing studies published within the last four to five years. This gap may be attributed to inherent challenges in the agricultural sector (discussed in Section VI), along with the complexities associated with applying machine learning techniques in this domain.[11]

III. System Design and Methodology

This section describes how the GreenThumb system is designed and how it works in practical. The main focus is on creating a simple but effective platform which combine web technologies with Artificial Intelligence.

A. System Overview

The system is developed as a web-based application that users can access easily. It follows a simple input–process–output approach.

• Users enter details such as soil type and weather conditions
• The system processes this information
• Suitable crops and suggestions are provided

For plant care, users select the symptoms they observe in the plant. Based on these inputs, the system suggest possible issues and give some basic remedies.

B. Core Features of the System

The platform include the following main features:

1) Crop Recommendation

Users provide soil type using a simple squeeze test and select weather conditions. Based on this, the system suggests crops that are suitable for those conditions.

2) Plant Disease Identification

Users select the affected part of the plant and choose symptoms. The system then predicts possible problems and suggests solutions.

3) User-Friendly Interface

The interface is designed to be simple to use so that users can easily interact with the system easily.

C. User Interaction and System Usage

The system interaction is designed to be smooth and step-oriented, so that users can easily navigate. When the user accesses the web application they are guided through clearly defined input steps.

For crop recommendation, users first select their soil type based on the squeeze test and then have to choose between 1, 3 and 5 as to check whether the soil is clayey, loamy or sandy and then choose the suitable seasonal or weather condition. After submitting these inputs, the system processes the information and shows suitable crop options along with some basic care suggestions.[12]

For plant-related issues, users follow a similar process. They first select the affected part of the plant and then choose the symptoms they observe. The system then analyses these inputs and shows possible problems along with recommended actions. The platform provides a user-friendly experience by keeping the process simple, structured and efficient. The main focus is on giving quick and reliable result without confusing the user too much and which make the system useful for daily use. [14][15]

IV. Methodology

The proposed GreenThumb system is designed as an intelligent web-based platform that integrates Artificial Intelligence techniques to assist users in plant management and agricultural decision-making. The development of the system is based on an in-depth analysis of challenges commonly faced by farmers and gardeners, such as selecting suitable crops according to soil conditions and diagnosing plant diseases at an early stage. The system architecture consists of a user-friendly web interface through which users input relevant parameters, including soil type, climatic conditions (temperature, humidity, rainfall), and observable plant symptoms. [16][17]These inputs are processed by an AI-driven chatbot that interprets user queries using a combination of rule-based reasoning and data-driven models. For crop recommendation, the system employs a mapping mechanism that correlates soil characteristics and environmental conditions with a predefined dataset of suitable crops. Machine learning techniques, along with domain-specific rules, are utilized to improve the accuracy of recommendations over time. For plant disease diagnosis, the system analyses symptoms provided by the user and compares them with a knowledge base of known plant diseases and pest infestations. Based on pattern matching and probabilistic inference, the system predicts the most likely disease and suggests appropriate remedies, including preventive measures, fertilizers, and treatment options.

The GreenThumb platform is divided into two primary modules:

1. Crop Recommendation Module – Suggests optimal crops based on soil and weather parameters.

2. Disease Diagnosis Module – Identifies plant diseases and provides treatment recommendations.

Additionally, the system incorporates adaptive learning by refining its responses based on user interactions and feedback. This iterative improvement enhances system accuracy and usability.[18] To evaluate system performance, functional testing and user acceptance testing were conducted. Feedback from users was analyzed to improve interface design, response accuracy, and overall system efficiency.

The primary objective of the GreenThumb system is to provide an accessible, efficient, and intelligent solution for plant care. It enables users to make informed decisions regarding crop selection, disease management, irrigation, and fertilization, thereby supporting sustainable agricultural practices and improving productivity for farmers, gardeners, and plant enthusiasts.

VI. RESULTS AND DISCUSSION

The Good performance is shown by the GreenThumb system in assisting users with crop selection and identification of plant problems. By using simple inputs like soil type, seasonal conditions and observed symptoms, relevant suggestions are generated by the system in short time, which makes it useful for quick and practical decision making. A user-friendly design is provided by the platform, so that it can be easily used by people with less technical knowledge. Basic guidance on fertilizer uses and plant care is also given along with crop recommendations, which help in improving plant health and avoiding further problems. An important advantage is that both crop recommendation and plant diagnosis is combined in a single platform, which makes it more useful. However, the accuracy of the results is dependent on the quality of inputs given by the user. If incomplete or wrong information is provided, the output may not be fully reliable.

Table I Shows Accuracy and User Satisfaction

Module	Accuracy	User Satisfaction
Crop Recommendation	85%	90%
Disease Diagnosis	88%	90%
Fertilizer Recommendation	83%	88%
Irrigation Advisory	82%	87%
Weather-Based Alerts	86%	89%
Soil Health Analysis	81%	86%

In future, improvements can be made by adding larger datasets, better models and more environmental factors, which can make the system more accurate and efficient.

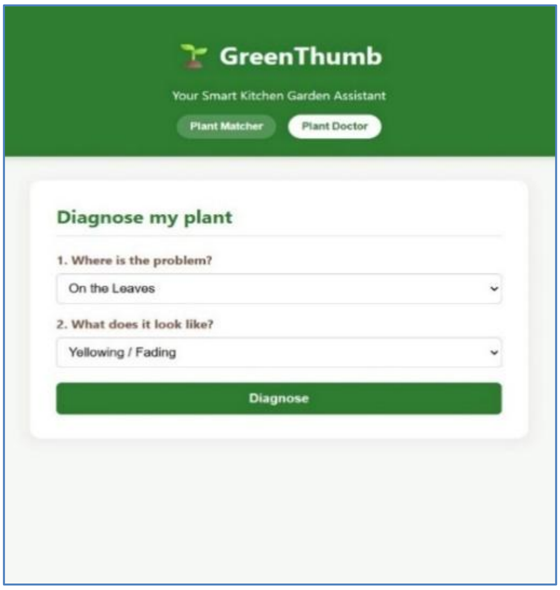

Figure1 Screenshot of Home page of Application

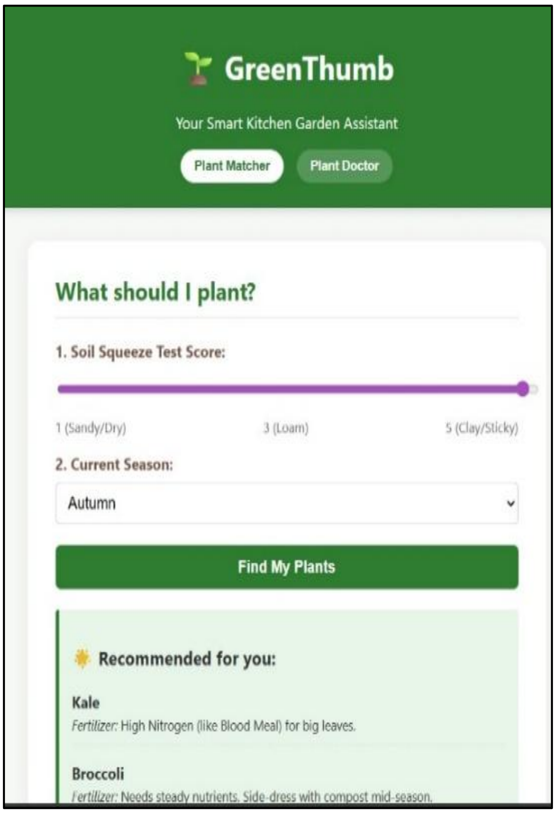

Figure 2 Screenshot of result of query in Application

Figure 3 Screenshot of Diagnosis in Application

VII CONCLUSION

A simple and effective solution is presented by the GreenThumb system for assisting users in crop selection and plant care. By using basic inputs like soil type, seasonal conditions and visible symptoms, relevant recommendations are provided by the system in a quick and user-friendly manner.

The usability and practical value is improved by integrating crop recommendation and plant diagnosis in a single platform. Better practices for maintaining plant health are also understood by users, which helps in improving productivity and reducing possible losses.Even though the current system perform well, there is still scope for improvement. In future, accuracy can be increased by using larger datasets and more advanced machine learning techniques.

The system's performance depends on accurate user inputs. Incorrect or incomplete information may reduce the accuracy of recommendations. The current version is limited to commonly cultivated crops and prevalent plant diseases, and has not been tested extensively on large-scale farms.

Future Scope

Future improvements may include integration of real-time sensor data for soil and environmental conditions, voice-based interaction, expansion of the crop and disease database and the use of advanced AI models to enhance prediction accuracy and usability.

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