PLANT HARVEST SYSTEM USING CNN

MINI PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this Report titled "**Plant Harvesting System**" is the bonafide work of **"Sanjeev U (210701232) Sai Krishna (210701219)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

This project develops a sophisticated Agricultural Assistance System that supports farmers in three ways: cost efficiency and productivity in farming. The first one has the ability to assist the farmer in predicting as to which are the right crops to cultivate by looking at the qualities of soil at hand, the Ph level as well as the real time prevailing weather conditions. This is achieved through a text classification machine learning model that can use the soil data inform of tuple and a weather API to post crop recommendations tailored for increasing crop productivity or changing fertilizer or input use in the case of crops. The second service that the project will be concentrating on is the process of identifying plant diseases through computer image processing. For example the CNNs can be applied to diagnose the images and the farmers can feed images of diseased plants into the system and the system would identify the nature of the diseases. The system works by referring to a large library of disease that provides specific information about diseases as well as the remedy for the diseases, which helps the farmer in the prevention of livestock diseases as well as the loss of the produce. The third function that would be of interest is to propose recommendations on fertilizing depending on the condition of the content of nutrients in the soil and the actual needs of the selected type of grown crops. The system also assists in identifying the current level of nutrients of the soil and the amount needed for the preparation of the crop and to recommend the amount to be applied based on the recommendation algorithm in order to improve growth of the crop and also to reduce cost. In general AgrAssist is an intelligent application system which is based on the advanced analytics and machine learning algorithms and image processing techniques to improve farmers' choices and experiences. It is a major source of information and guiding decision making for the farmers to adopt sustainable and productive ways of utilizing the available agriculture resources in a way that maximizes agricultural productivity and resource use efficiency.

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CHAPTER 1
INTRODUCTION

1.1 GENERAL

Agroassist is an innovative agricultural assistance system which focuses on providing support for farmers to achieve cost efficiency and productivity. The system aids farmers in three critical areas: Geneticist—selection of crops and their disease identification and fertilization. Firstly, the current weather conditions and soil quality in each region together with the pH levels are analyzed and predicted values which show the production of the best crops in the region using text classification and machine-learning algorithm as well as weather API. This will lead to designed crop recommendations to enhance production as well as efficiently use inputs. Secondly, the system is based on artificial intelligence and computer image processing – the system segment responsible for disease identification uses CNNs to determine the disease based on the uploaded images – an extensive database containing plant disease descriptions as well as remedies is used for the purpose. Finally the experts at AgrAssist make nutrient managements recommendations on the basis of soil nutrient status as well as nutrient requirements of the crop and recommends the quantity of nutrients to be applied for best crop growth and costs. Taking into account abilities in generating predictive analytics, ML analysis and image recognition, AgrAssist helps the agricultural community to choose the most effective and sustainable practices for maximizing its efficiency.

1.2 OBJECTIVE

The following project details on the development of an Agricultural Assistance System that is well-known for the effective assistance of farmers in their decision-making in relation to the practice of sustainable agriculture supported by the evidence that is provided from the system. The system has three primary features:: The system has three fundamental properties:

Crop Prediction: Through this feature the best suitable crops to grow at a specific time based on the real time parameters of weather which affects the soil like whether the soil is rich in nutrients or not and whether its pH is acidic or basic. Information from weather API and soil analysis would ensure that the farmers would access recommendations adapted to their climatic and soil condition.

Plant Disease Identification: It enables farmers to upload photos displaying plants having the diseases while the CNN-based system will function to pinpoint them. This section of image processing solution identifies the plant diseases and features an overview of the condition and the means of its treatment and has the support of a wide database on plant diseases.

Fertilizer Advisory: It also supplies custom fertilizers depending on the kind of nutrients needed by the soil and crop type. It has an advanced algorithm that improves the calculation of the nutrients that are to be applied in a manner that promotes the best growth of the plant throughout its life in addition to its cost.

1.3 EXISTING SYSTEM

The current agriculture industry is full of numerous challenges – from the choice of crops to the control of illnesses and soil quality. Current technologies and the methodologies utilized in the past have their weaknesses that this project is seeking to address.

1.3.1. Crop Selection:

Traditional Methods: Farmers also use traditional heuristics such as experience, past data, and local farming industry experience to choose the crops to plant. Such approach although very important may not translate to optimum choice of crop as may be determined by current status of the soil and the prevailing weather conditions.

Existing Technologies: There are currently available some systems that deliver primary soil analysis and general crop suggestions. But these systems largely cannot support any interface with the current weather and adaptive prediction models.

1.3.2. Plant Disease Management:

Traditional Methods: It is not generally difficult for farmers to identify the plant diseases visually and consult with the agricultural experts or refer to the reference materials for the information about plant disease. The process can also be cumbersome and very time-consuming, especially, if the farmers are not well accustomed to farming.

Existing Technologies: Popular types of technology for farmers right now include a mobile disease diagnosis app and online websites where farmers can manually type out the symptoms and get a diagnosis of a certain disease. There are also basic cell image recognition apps but they are less accurate and have very small data base for disease identification.

1.3.3. Fertilizer Advisory:

Traditional Methods: The use of fertilizers may be purely based on a routine schedule and generalized recommendations without fine-tuning of the application to the soil nutrient levels and the needs of crops. This can result in excessive or insufficient application of fertilizers, with consequences on both expenditure incurred and the well-being of crops.

Existing Technologies: There are some systems that offer soil testing services and give very simplistic recommendations on fertilizers. But these recommendations are usually not specific for various crops' nutrient needs and depend on the soil; their recommendation practices are static.

1.4 PROPOSED SYSTEM

Agricultural Assistance System proposes the idea of having an interphase that will tackle the issues of crop choice, disease identification, and fertilizer application in a more integrated and data-driven solution for farmers. The most critical components of the system are disease identification through image processing; the prediction of crop yield through data sample analysis of soil and weather data; and the use of the nutrient content of soil and plants to supplement the use of fertilizers.

The crop prediction feature uses the soil nutrient levels and pH levels, weather condition measurements at the time, to be able to determine the best crops to plant in that location. Farmers enter the result of soil test, and the system pulls information through a weather API. ALM uses a combined data and outputs the specifics on the selection of crops that will be beneficial while enhancing the yields and resources used in the fields.

This can include a facility that enables farmers to upload images of plants under disease investigation. It performed a convolutional neural network to process these images and diagnose diseases. The Plant Village is a database of various plant diseases that includes ample illustrations and descriptions of plant diseases plus recommended approaches for control and treatment, thereby providing a rapid platform for the diagnosis of plant diseases and quick interventions to minimise plant losses.

The advisory section in the fertilizer enables the user to receive personalized information needed after determining the status of the nutrients in the soil and the nutrient needs for a chosen product. Acting as a feedback loop, the system measures soil nutrient levels either on a regular basis or in real time by means of mass spectroscopy and then offers to the user a recommendation generated through a recommendation algorithm as to the kind of fertilizer that is desired and in what quantities to be delivered. This will ensure they have accurate nutrient application, they can save on cost and they can also get an improved crop growth as well as improved soil health.

The interface of the system must be easily understood by the user, available through a web or mobile interface and must have well structured input fields for soil data and image submission. Presentations of results and recommendations are done in simple and understandable ways enabling farmers to effectively utilize the gained insight. Privacy management strategies are involved with data management that must be done in an efficient way in order to keep track of users and product history in order to provide useful suggestions in the future.

CHAPTER 2
LITERATURE SURVEY

Thus, the use of agriculture technology in recent years has developed rapidly because of the challenges that have been faced in the area of food security, and the related problems of resource scarcity or climatic change. The prediction and recommendation on crops has been a major field under the artificial intelligence system with the use of machine learning algorithms for the analysis of soil texture on crops, climate weather and history of the crops produced. These algorithms produce modeling arrangements for the farmers who use them to make decisions on the types of crops to grow, the planting times and when to allocate resources on the fields. Besides, identification of plant disease using images has been made easier by the use of computer vision system techniques such as convolution neural network in the recent past. Such models use deep learning to examine images of specific plant diseases to identify and classify such diseases and facilitate the early detection of conditions that cause damage to crops.

In parallel there has been the development of fertilizer advisory systems approach which has highlighted the importance of data-driven approach for optimizing nutrient-wise management. These systems combine soil analysis, crop simulation models and climate information to provide farmers with customized advice on what and how much nutrients to use based on crop and soil needs. In addition, the ability to combine various tools like IoT sensors, satellite imagery, and cloud computing components has made it easier to design robust agricultural decision support systems. Real time data analytics and intelligent automation help these systems to monitor farm conditions, predict trends and guide best farming practices towards increased production efficiency in terms of resource utilization.

Blockchain technology has also been identified as one of the most effective innovative approaches for improving the level of transparency and traceability of the entire agricultural value chain. Blockchain ensures mechanisms of data recording are authenticated and verified and form part of the chain of events that occur in the value of food products, from farmer to consumer through the production process in an open book. This promotes food safety and food security and also allows for the prevention of food fraud and builds consumer confidence of agricultural products. Vertical farming and urban agriculture have also emerged as viable food production concepts – especially in cities with limited and costly land.

Following the combination of Internet of Things and analytics in agriculture has resulted in precision agriculture, which has supported farmers apply resources and achieve higher productivities in farms. IoT sensors offer solutions from the perspective of soil moisture, temperature, and crop health, which can give detailed information about actual conditions in the field and the condition of crops for irrigation or combating pests. Additional technologies that have been pivotal in the development of modern agriculture include satellite image and remote sensing applications that give accurate information about growing crops, the type of soil and how the environment is changing. These technologies provide the capacity to farmers to detect crop stress or disease, or evaluate the productivity of an crop-productive practices.

Data analytics and predictive modeling help farmers to make accurate predictions in real-time for increasing the productivity of agriculture. Big data models are used to process large amounts of both historical and live data to make predictions about the future occurrence of specific events, which can shape the farmer's expectations on weather-related risks, market volatility, and plant production. It is also observed that new climate smart technologies and practices for enhanced resilience to climate change and impacts, GHG emissions reduction and improved farm productivity are being embraced in agriculture.

Various farmers and scientists have begun to recognize the benefits of both agroecological methods as well as sustainable farming practices like crop rotation and cover cropping and integrated pest management in improving the quality of soil, water, and biodiversity. In contrast to conventional farming practices, agroecology is a more sustainable mode of managing agriculture by replicating the natural ecosystems and eliminating the reliance on external inputs in the farming systems. Another sustainable model has been the concept of regenerative agriculture which involves ecosystem building through farming practices that improve the soil's organic matter levels and therefore its capacity to store carbon. Through the use of various soil health enhancing strategies including no-till farming and rotational grazing, farmers can enhance soil health and increase soil organic carbon sequestration to reduce climate change by absorbing carbon dioxide into the ground.

Some of the topics that are covered within the research of agriculture and technology include the following: The analysis of the new equipment that has been developed for the improvement of agricultural practices. There are already quite a lot of studies on the topic of crop recommendation and prediction models, which base on machine learning algorithms and make crop recommendation based on soil characteristics, climate conditions, and historical yield data to improve the efficiency of agricultural production. Meanwhile studies related to image processing of plant disease identification using convolutional neural networks (CNN) research works have been done showing potentials in automating plant disease detection and classification on images. However, research into fertilizer advisory systems has mainly focused on modeling recommendations based on the data-driven approaches such as the calculation of quantities of fertilizers to recommend based on the nutrient levels in the soil and the crop requirements for the nutrients as well as the analysis of the climate conditions in the field. Another relevant research topic is the integration of IoT sensors, satellite images, and cloud computing platforms to: effectively develop the all-embracing agricultural decision support systems for timely and targeted information and visualization, automatic monitoring and analysis, and automated predictive models for productivity and efficiency improvements in farming. Study on technology adoption and assimilation barriers in the farm sector: Interface design and adoption issues have also been investigated and these have highlighted the need to have user-friendly interfaces as well as the use of mobile applications and interactive visualization tools to allow easy user acceptance and adoption of technology-enabled agricultural solutions for farms. In conclusion, it can be stated that the literature review supports the importance of using technology to combat agricultural issues and demonstrates that a combined approach will provide farmers with effective tools based on data analytics to advance sustainable production in the industry.

CHAPTER 3
SYSTEM DESIGN

3.1 GENERAL

System design involves the formulation and creation of systems that meet the specific needs of users. Fundamentally, the essence of studying system design lies in comprehending the individual elements and how they interact with each other.

3.2 DEVELOPMENT ENVIRONMENT

3.2.1 HARDWARE SPECIFICATIONS

This document offers a comprehensive overview of the hardware and its implementation, detailing the key components, their interactions, and the necessary requirements for seamless connectivity to utilities and installation.

Table 3.2.1 Hardware Specifications

PROCESSOR	Intel Core i5
RAM	4GB or above (DDR4 RAM)
GPU	Intel Integrated Graphics
HARD DISK	6GB
PROCESSOR FREQUENCY	1.5 GHz or above

3.2.2 SOFTWARE SPECIFICATIONS

The below table constitutes a thorough evaluation of requirements that precedes the more detailed phases of system design, aiming to minimize the need for subsequent revisions. Furthermore, it should offer a practical foundation for estimating product expenses, potential risks, and project timelines.

Table 3.2.2 Software Specifications

FRONT END	Flask, Python
BACK END	Python
FRAMEWORKS	Pytorch, Tensor Flow
SOFTWARES USED	Visual Studio, Jupyter Notebook

3.3 SYSTEM DESIGN

3.3.1 ARCHITECTURE DIAGRAM

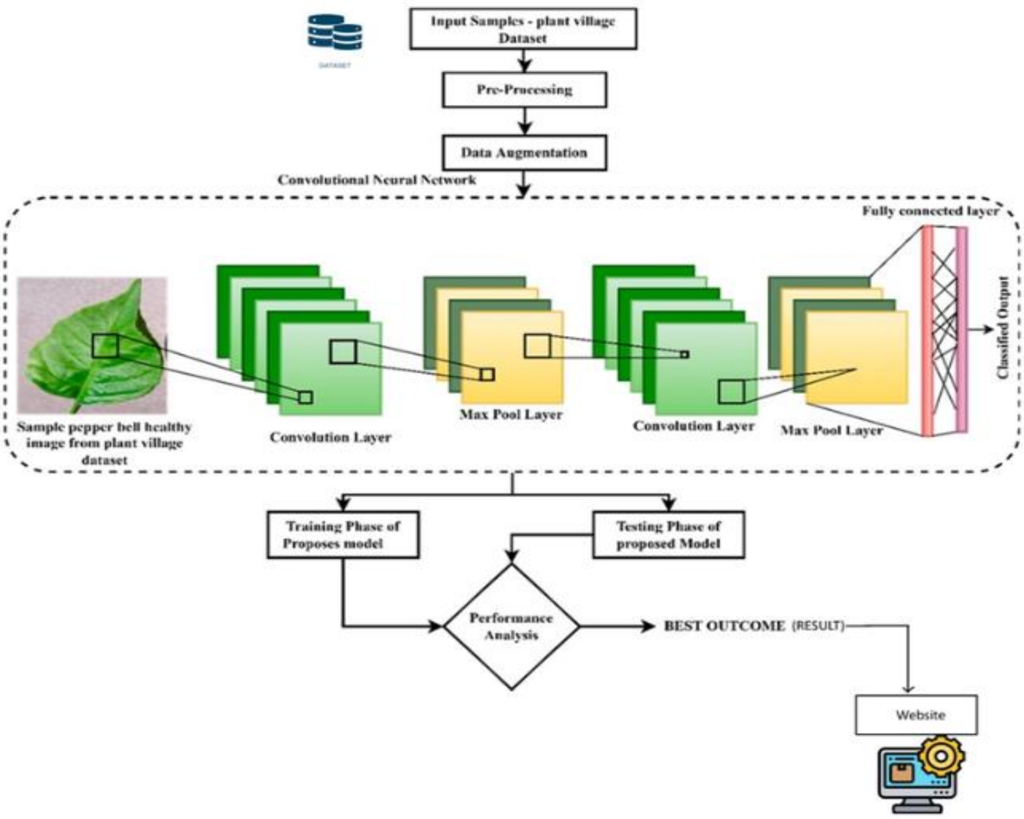


Fig 3.3.1 Architecture Diagram

The diagram of the architecture of the Agricultural Assistance system is given below to understand the architecture of the system and make representation of interconnections among all of the components. At its center are three main modules: HI-PEAK: Predicting Crops, Diseases and Fertilizers. These modules feed on the inputs that come from the user interface where the farmers directly engage with the system and supply information like soil test and pictures of sick plants. The Crop Prediction module involves the application of machine learning algorithms to make forecast of the nutrient content in the soil, the climate, and the ph level of soils to suggest the kinds of crops which may be well suited for a region. The Disease Identification module is also the use of images processing methodologies which include the use of convolutional neural network (CNN) to analyze uploaded picture and identify diseases from the image file and for this CNN, it draws its data base of the known diseases of plants. The Fertilizer Advisory module provides tailored responses on fertilizer rate according to nutrients found in the soil as well as the crop nutrient requirement. Other reasons, the system may also need to connect with the weather API to get the weather data and the database for getting the disease information. Memory units are data storage components that are used in the storage of user information, historical data, and other process data for analysis and better decision making. Overall, the architecture diagram below answers the needs of how the system works in order to supply agronomists' and farmers' with recommendations to manage the farm

CHAPTER 4
PROJECT DESCRIPTION

4.1 MODULE DESCRIPTION

AASe has several modules, some of which are responsible specifically for certain functions that are necessary to ensure that the right advice is given to farmers. Here are the main modules and their descriptions:The major modules and their descriptions are:

4. 1. 1 User Interface Module:

Description: This medium is therefore the channel through which the users interact with the system to run their activities. It involves online as well as offline applications that are user-friendly and easy to understand offering the farmer the opportunity to enter his or her data, upload images, and have the recommended responses.

Functionality: A feature that helps the user to interact and input information with the help of such elements as a search bar and buttons for navigation through the recommended content.

4. 1. 2 Crop Prediction Module:

This is why students get used to accepting what is given to them and do very little to the systems in their colleges.

Description: It has the potential to easily implement machine learning algorithms to determine the appropriate crops which should be cultivated for a particular pH balance of the soil, nutrients in the soil, and weather conditions. It can also be an opportunity for farmers to choose the right crops to take in order to gain high harvests and avoid the wastage of resources.

Functionality: Predicts soil and weather factors and selects models that work for a particular condition to make a decision on the recommendation.

4. 1. 3 Disease Identification Module:

Description: The second method is called computer vision that uses algorithms like convolutional neural networks to analyze uploaded photos of infected plants by those who are learning the model. It is executed to crop analysis; It is implemented to disease detection; It identifies the disease and provides you the information when which you have to treat the plants if you are a farmer to avoid the losses of the plants.

Functionality: It can be automated to a level where images of the plant diseases sent will automatically compare with a database of plant diseases and accurate diagnosis and treatment advice will be forwarded to the owner of the plant.

4. 1. 4 Fertilizer Advisory Module:

Description: Provides recommendations to farmers of the amount of fertilizers to purchase depending on soil nutrient content and the demand of the specific crop. It helps to manage fertilizer application to agriculturists on the path to full input utilization, cost-effective inputs, and healthy crop production.

Functionality: Calculates the fertilizer needs using an algorithm based on a data on nutrient concentration in soil and recommends specific type and amount of fertilizer to use.

CHAPTER 5
IMPLEMENTATION AND RESULTS

5.1 IMPLEMENTATION

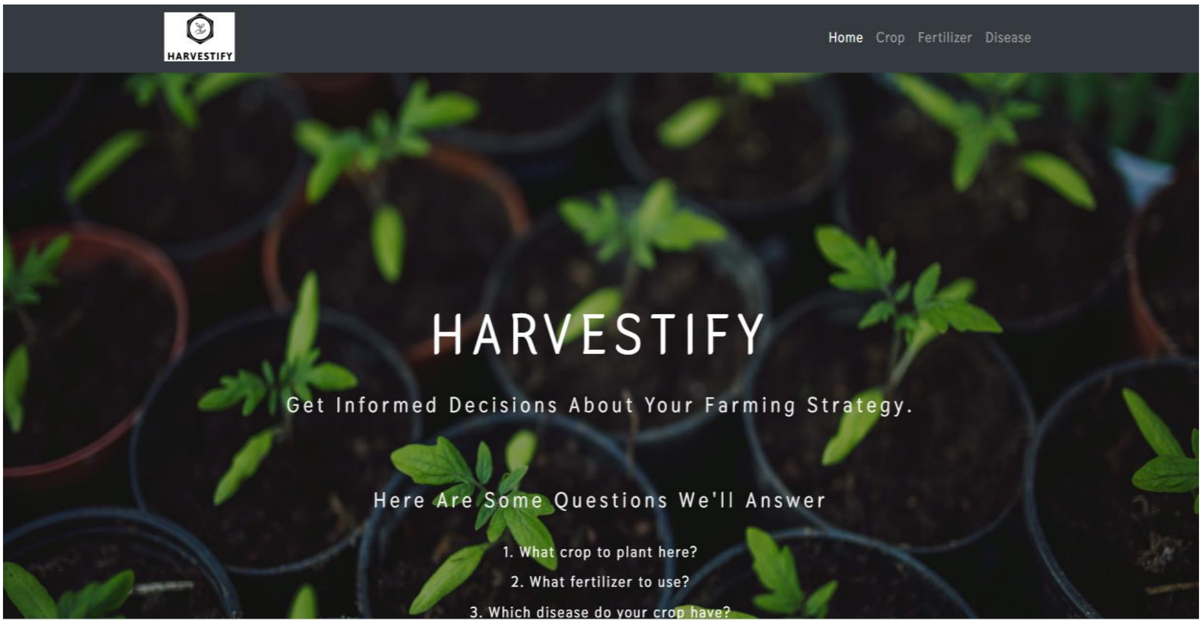
Putting in place the Agricultural Assistance System starts with gathering extensive datasets required by the Agricultural Assistance System. These datasets cover soil nutrient metrics, historical harvest information, weather condition information, photos of plant diseases, and recommend fertilizer based on the observations of agricultural principles. After being collected, machine learning models then begin their process of development. Machine learning algorithms such as long short-term memory networks are used to train models for the Crop Prediction Module using historical data on crop yields, soil characteristics and weather conditions for prediction of the right crop for a given place. Likewise, the Disease Labeling Module consists of the implementation of machine learning algorithms—primarily CNN—to determine plant diseases based on the image color features; this is achieved through the Disease Naming system. However, the Fertilizer Advisory Module has to be developed to its intelligence and the information needs to be converted into algorithms which will analyze the soil nutrient data and advice what fertilizer has to be applied in the field as per the crop requirement.

The next stage of software development consists in an attempt to write behind-the-scenes parts for the UI and to code the graphical user interface. Graphical system designed is used to provide the user to enter data, upload the pictures of the agricultural products with ease and view the result in a format which can be easily used and followed by the farmers and other professionals within the agricultural field. The backend entails the processing of inputs from the users through different views that the user is able to interact with and also the interaction when called to work with weather data collected from external API's or access to a trained and integrated ML model for accurately classifying crops or potential disease indication. When a system is in the process of development then crucial features like scalability and users security are given more emphasis that they will be able to function optimally and with ease.

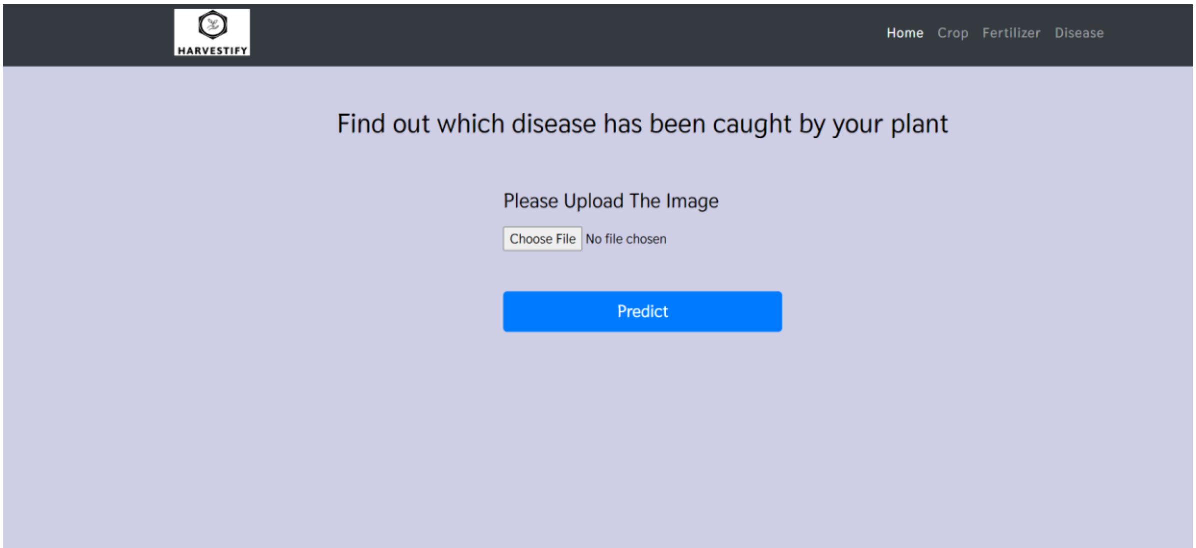
Integration and testing are based on software development which is carried out to ensure that each module within the system is adequately accurate and reliable. Several quality assurance techniques are applied to ensure that potential errors are efficiently detected and eliminated from the integration process. Once the system has been thoroughly tested and considered satisfied the validation phase has been completed and the system is ready to be deployed. Deployment encompasses the procedure and mechanism for running an Agricultural Assistance System on the cloud or any other form of server including an on premises server and its cross compatibility with different platforms and browsers.

Post deployment, the duty of the Agricultural Assistance System will be to maintain, update, and enhance the system through regular process defects detection and management. This includes debugging the system, gathering product user review information and continuously improving their performance, and updating the machine learning model with new data once in a while. Additionally, seeking ways of enhancing the system functionalities of the system for instance by adding new features or features that may be lacking in the existing technology most exactly applied in agriculture will make the system to be more helpful to the farmers. The Agricultural Assistance System can be very effective in equipping the farmers with the information which they need to take actions that will help them to improve on their agricultural techniques of increasing the level of production.

5.2 OUTPUT SCREENSHOTS



Home page of app



disease prediction page

Cause of disease:

Gray leaf spot lesions on corn leaves hinder photosynthetic activity, reducing carbohydrates allocated towards grain fill. The extent to which gray leaf spot damages crop yields can be estimated based on the extent to which leaves are infected relative to grainfill. Damage can be more severe when developing lesions progress past the ear leaf around pollination time. Because a decrease in functioning leaf area limits photosynthates dedicated towards grainfill, the plant might mobilize more carbohydrates from the stalk to fill kernels.

How to prevent/cure the disease

1. In order to best prevent and manage corn grey leaf spot, the overall approach is to reduce the rate of disease growth and expansion.
2. This is done by limiting the amount of secondary disease cycles and protecting leaf area from damage until after corn grain formation.

Diesease predicted using best Ml Algorithm

5.3 RESULT ANALYSIS

The modules of the Agricultural Assistance System aid farmers in making the best decisions for their agricultural activities through producing individualized recommendations and strategies for the farmers based on the data input. The Crop Prediction Module: Through the Crop Prediction Module, the system collects the soil nutrient content, soil pH levels and weather conditions to obtain the suggested kinds of crops to plant that will give the right yield and use the resources properly. The Disease Identification Module entails the use of image processing to detect plant diseases by uploading images to obtain detailed analysis and remedies for minimizing the results of crop loss and improving plant health. Another aspect of the STARD system is the Fertilizer Advisory module which generates personalized fertilizer recommendations based on the soil nutrient levels and the current nutrient needs of the crop to promote more efficient and economic use of nutrients. These functionalities can be combined and information can be complemented with the use of powerful technologies that would allow the system to be a powerful tool used to help farmers on maximizing their farms' potentials as well as ensuring that the agriculture industry is sustainable.

CHAPTER 6
CONCLUSION AND FUTURE ENHANCEMENTS

6.1 CONCLUSION

In conclusion, Agricultural assistance system is an integrated and centralized service to deal with problems of the farmers. Since the processes are based on the machine learning algorithm and driven by data, the system provides advice in case of the choice of the crop, the decision on disease control and the selection of fertilizers. It may assist in the acquisition of real-time data from the farms and facilitate the integration of the system with the satellite imaging technologies that can be applied to real-time data analytics and predictive analysis technologies that can aid in the enhancement of working process efficiency and productiveness.

Some of the potential opportunities that the AA System's deployment could realize include contributing to agricultural sustainability in the age of climate change risks. It helps in making time effective and wise decisions there by helping the farmers in the right way to use the resources towards higher yielding potentials. Moreover, its ability to be simple to operate makes it much easier for farmers to learn how to operate compared to the majority of current applications, thus generating more users who will know how to use it and spread the use of it.

They will also need to monitor the system to ensure that it operates optimally and engage in constant maintenance and repair works for the system to function as effectively. Constant change is also beneficial for the system because this means that the system is capability is responsive to technology or user opinion/feedback so that the system is capable of addressing food good production needs in agriculture. Ultimately, through the comparison of the Agricultural Assistance System with Gledhill's utopian vision of how technology will re-imagine farming in the face of environmental destruction and population efflux; it becomes clear that the Agricultural Assistance System represents the promise of technology in the future.

6.2 FUTURE ENHANCEMENTS

- Cycle based modelling to increase performance of predicting machine learning model.
- Upgrades in infectious disease diagnostics and the promises of real-time disease tracking networks.
- For instance- crop varieties development for drought tolerance examples.
- New markets and new crops: diversification to other geographical niche markets.
- Recommendations: Integrate educational features and content to engage users to empower farmers and contribute to maximum system productivity.

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