PROJECT BASED LEARNING (PBL-2) LAB (CSP297)

Artificial Intelligence in Agriculture

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SECTION: C

Submitted To

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Project Title

"AI-Driven Precision Agriculture: Optimizing Crop Yield and Quality"

Team / Group Formation:

S. No	Student Name	Roll Number	System ID	Role
1	**Rishabh Kushwaha**	**2201010575**	**2022448095**	**Model training**
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Technologies to be used

Software Platform

a) **Front-end :** Html and CSS
b) **Back-end :** Python
c) **Model Training :** Tenserflow and Keras

Hardware Platform

RAM, Hard Disk, OS, Editor, Browser, GTX , Jupyter Notebook etc.

Tools

Plants leaf database - Healthy , Disease leaf .

Problem Statement

Creating and deploying artificial intelligence (AI) tools especially suited for agricultural leaf disease detection is the current challenge. The task at hand involves using artificial intelligence (AI) methods, namely machine learning and computer vision, to evaluate digital photos of plant foliage and promptly and precisely detect illness indications. This entails spotting any abnormalities, such as discolorations, lesions, or patterns, that point to different leaf diseases.
To maintain crop health and output, the agricultural industry must properly detect and manage leaf diseases. Conventional disease detection techniques might be ineffective and prone to human mistake, which would raise farmers' financial losses and delay reaction times. In what

ways might artificial intelligence technologies be applied to the development of precise and effective methods for the early identification and detection of leaf diseases in agricultural crops?

Project Description

The project's goal is to create a solution based on artificial intelligence for agricultural leaf disease early detection. There is a growing interest in using technology, especially artificial intelligence (AI) and image processing techniques, to address these difficulties due to the growing need for sustainable farming practices and the need to reduce crop losses from illnesses.

1. Data Gathering and Preparation: To support the project, a variety of leaf photos representing different crops and the diseases they are linked to will be gathered. The excellent quality and relevance of these photos for model training will be ensured by curation, annotation, and preprocessing.
2. Algorithm Development: For disease detection tasks, cutting-edge deep learning and machine learning algorithms will be investigated and put into practice. To accurately categorize leaf photos into healthy and unhealthy groups, feature extraction, model training, and optimization will be required.
3. Model Validation and Evaluation: Strict evaluation procedures will be used to gauge how well the created algorithms function. To make sure the models are robust and can generalize, this will involve holdout validation, cross-validation, and possibly external validation on separate datasets.
4. Integration and Deployment: Farmers and other agricultural stakeholders will be able to effortlessly upload leaf photos for real-time disease diagnostics by integrating the created models into an intuitive software application or web-based platform. The platform will be built with efficiency, scalability, and cross-platform accessibility in mind.

Project Modules: Design/Algorithm

1. Gathering and Preparing Data:
    - Create a methodical strategy to get photos of leaves that depict both healthy and unhealthy plants.
    - To improve the quality and diversity of datasets, apply preprocessing techniques including picture scaling, normalization, and augmentation.

2. Feature Deletion:

    - Examine several feature extraction techniques, such as deep learning-based feature learning methods and conventional handcrafted features, that are appropriate for detecting leaf diseases.
    - Create algorithms to extract characteristics from leaf images that are discriminative, with an emphasis on identifying distinctive patterns linked to various diseases.

3. Selecting a Machine Learning Model:

    - Assess the efficacy of several machine learning algorithms in the classification of leaf illnesses, including Support Vector Machines (SVM), Random Forest, and Convolutional Neural Networks (CNNs).
    - Create tests to evaluate how well various models perform in terms of metrics like F1-score, accuracy, precision, and recall.

Implementation Methodology

- ❖ Data Gathering and Annotation: Compile a varied collection of leaf photos that illustrate various leaf ailments and crops. Label the photos by hand in order to give the AI model ground truth information for training.

- ❖ Model Development: To create reliable models for the diagnosis of leaf illness, experiment with different machine learning strategies, such as convolutional neural networks (CNNs). To increase performance, use transfer learning approaches to fine-tune the models.

- ❖ Interface Design: Create an intuitive user interface for farmers to engage with the AI system, such a web platform or mobile application. Include functions that allow users to upload images, diagnose diseases, and receive actionable advice.

- ❖ System Implementation: To allow real-time illness detection on farms, deploy the AI model on cloud-based servers or edge devices. To provide a seamless user experience, integrate the model with the user interface.

- ❖ Field Testing: To assess the AI system's functionality and effectiveness in actual agricultural settings, conduct field tests in cooperation with nearby farmers. Get user input to determine what needs to be improved.

- ❖ Impact Assessment: Examine how applying AI-driven disease detection in agriculture would affect the environment and the economy. Calculate the advantages, such as increased production, lower input costs, and less need for pesticides.

Result & Conclusion

Artificial intelligence (AI) has demonstrated encouraging results in the detection of leaf diseases in agriculture, and it holds great promise for resolving issues related to crop health management. We have successfully demonstrated the ability to precisely detect and categorize a variety of leaf diseases in crops through the creation and application of AI models.

1. Accuracy: The AI models outperformed conventional techniques of disease detection, achieving high accuracy rates in identifying leaf illnesses. For the purpose of preventing agricultural losses, early disease detection and prompt action depend heavily on this accuracy.
2. Scalability: The ability of AI algorithms to scale allows for their application in a variety of agricultural contexts and crop varieties. Artificial intelligence (AI) solutions can be tailored to fit different agricultural environments, whether they are used in smallholder plots or huge commercial farms.
3. Efficiency: When compared to manual inspection techniques, AI-based disease detection systems are more efficient. By automating the process, farmers may more efficiently monitor vast agricultural areas by reducing the time and effort needed for disease identification.
4. Cost-effectiveness: Although creating AI models and putting monitoring systems in place may need some early setup expenditures, the long-term advantages outweigh the costs. Cost-effectiveness is enhanced by a decrease in the need for physical work and an improvement in crop output brought about by prompt disease management.

Future Scope and further enhancement of the Project

The "Artificial Intelligence in Agriculture for Leaf Disease Detection" project has established a strong basis for future developments in crop health care. Although the results of the current implementation are encouraging, there are still a number of opportunities for further study and development to increase the system's usefulness and efficacy.

1. Model Refinement:

   ❖ Algorithm fine-tuning: To improve disease detection accuracy and robustness, machine learning algorithms should be continuously improved. This entails incorporating cutting-edge deep learning architectures, investigating ensemble techniques, and optimizing hyperparameters.

   ❖ Examine whether transfer learning approaches may be used to leverage pre-trained models and modify them to fit certain crop species and disease kinds. With minimal data, this method can increase performance and speed up the construction of the model.

2. Data Gathering and Augmentation:

   ❖ Expand the dataset by using data augmentation techniques including picture noise addition, scaling, and rotation. Reducing overfitting and enhancing model generalization can be achieved with a larger and more varied dataset.

   ❖ Crowdsourced Data Collection: Assist farmers and farming communities in gathering and labeling picture data from various climates and locations. Initiatives aimed at crowdsourcing can assist in creating extensive datasets that accurately reflect real-world circumstances.

3. Development of Mobile Applications:

   ❖ User-Friendly Interface: Provide mobile applications with an easy-to-use interface that let farmers quickly take and submit pictures of sick leaves for examination. Farmers with different degrees of technical ability might use intuitive interfaces that need less user input.

   ❖ Decision Support System: Combine a decision support system that offers practical advice based on diseases identified with the disease detection system. Farmers can get advice on how to control diseases, such as applying pesticides and rotating their crops.

Advantages of this Project

1. Early Detection: By facilitating the early identification of agricultural illnesses, the method helps farmers to limit crop losses and stop the disease's spread.

2. Accurate Diagnosis: By minimizing misdiagnosis and needless treatments, artificial intelligence systems are able to diagnose crop diseases with accuracy and reliability.

3. Cost-effective: The technology saves farmers time and money by eliminating the need for manual inspections and laboratory testing.

4. Enhanced Crop production: Better crop quality and production are the result of prompt disease control and timely intervention.

5. Sustainable Agriculture: The system supports ecologically friendly agriculture by encouraging sustainable agricultural methods like crop rotation and the planned application of pesticides.

Outcome

In the end, farmers, consumers, and the environment stand to gain from the project's predicted favorable effects on agricultural production, sustainability, and resilience.

References

- Jupyter notebook
- Tenserflow

Signature

Student Name	Student Sign	Faculty Name	Faculty Sign