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Hemp Disease Detection andClassification using Machine Learning

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Abstract: **The project aims to create an efficient and effective method for the identification and isolation of diseases affecting cannabis plants. Marijuana is a versatile plant with commercial and medicinal uses. The plant is easy to grow and care for and is suitable for all climates. But like other plants, cannabis disease can affect the plant's growth and have a significant financial impact on cannabis production. The project aims to use the power of machine learning to increase the accuracy and speed of disease diagnosis by identifying characteristics such as leaf changes, growth patterns, texture or softness or squishiness. This research aims to improve early detection and management of these diseases in cannabis cultivation by creating a robust model learned from different datasets of cannabis plant images, good models learned from many different cannabis plants.**

1.INTRODUCTION

The primary goal of this project is to develop a robust and efficient system for the automatic identification and classification of diseases affecting cannabis plants. Using machine learning techniques, theproject aims to analyze various aspects such as leaf changes, growth patterns and texture/softness variations to increase the accuracy and speed of disease detection. The key goal is to create a high-quality model trained on a diverse dataset of cannabis plant images to facilitate early disease detection and treatment. This, in turn, is expected to contribute to increased yields, sustainable hemp cultivation and economic stability in thehemp industry.

In this report, we present the architecture andimplementation details of our hemp disease detection model,evaluate its performance on a test dataset, and discuss potentialimprovements and future directions for research in this domain.

2.PROBLEM STATEMENT

The cannabis industry faces major challenges in identifying and classifying diseases affecting cannabis plants. Although very effective and has the potential to be commercial and medicinal, hemp cultivation is susceptible to many diseases that can affect the growth of the plant and therefore the economic benefits of hemp production. Timely and accurate detection of these diseases is important for good disease control and permaculture. The routine process of identifying a virus can be time-consuming and confusing. Therefore, it is necessary to develop technology that uses technology to increase the speed and accuracy of diagnosing diseases in cannabis plants.

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3. METHODOLOGY

Data preprocessing module: focuses on cleaning and preparing raw image data for machine learning. Thisincludes tasks such as resizing images, normalizing pixelvalues, and accounting for lighting and post-processing. **Image feature extraction module**: Extract relevantfeatures from marijuana plant images. This may includetechniques such as extracting texture features, extractingcolor histograms, or using pre-trained neural networks(CNN) for feature extraction.

Convolutional Neural Network (CNN): The main machine learning technique is Convolutional Neural Network (CNN). They have convolutional layers that take the spatial hierarchy of features from input images and learn adaptively.

In this project, TensorFlow serves as the underlying machine learning framework that provides a versatile platform for building, training, and evaluating Convolutional Neural Networks (CNNs) for the detection of cannabis plant diseases. Acting as a high-level neural network API, Keras integrates seamlessly with TensorFlow to simplify the implementation of CNN architectures and make model development more affordable. OpenCV, a computer vision library, is used for basic image processing tasks such as loading, color space conversion, and resizing. ImageDataGenerator, a component of Keras, plays a key role in real-time data augmentation during model training, contributing to the diversification and improvement of the training dataset. This combined use of TensorFlow, Keras, OpenCV and ImageDataGenerator forms a cohesive ecosystem that simplifies the development of an efficient and accurate automated system for the identification and classification of diseases affecting cannabis plants.

4. ARCHITECTURE

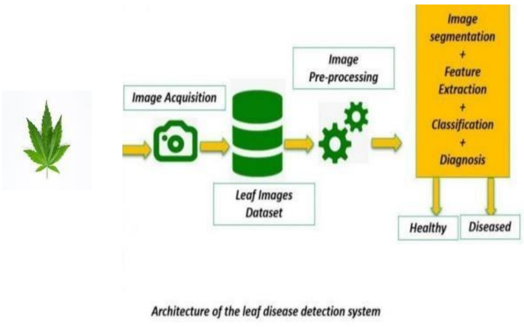

Figure 1 Architecture

The architecture of an cannabis plant disease identification and classification system is a multi-layered process designed to closely match key components. The image acquisition process captures high-quality images from the crop field and feeds them into a data front layer that cleans and creates the data. Next, the image feature extraction layer uses techniques such as texture analysis or convolutional neural networks to extract features. The machine learning model training layer uses algorithms such as SVM or CNN to learn from different datasets, while the model evaluation layer evaluates its performance. The database system manages images and user data, the notification system sends alerts, and the update and maintenance system optimizes the system. The ethics and privacy process addresses ethical considerations through an integrated framework that facilitates integration with existing technologies. The data and reporting layer creates comprehensive information that helps create a well-informed and effective cannabis plant disease identification and classification system.

5. DESIGN

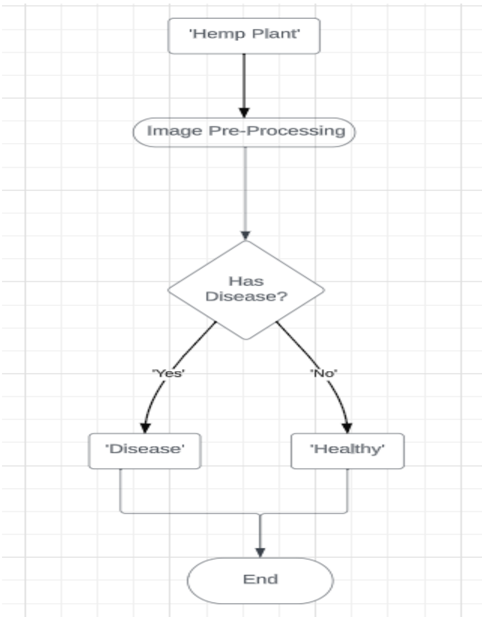

Figure 2 Flow Diagram

The design of this project is aimed at creating an efficient and user-friendly automated system for the identification and classification of diseases affecting cannabis plants. The image data undergoes preprocessing using OpenCV, including resizing and normalization, ensuring compatibility with a convolutional neural network (CNN) model developed using TensorFlow and Keras. The CNN architecture is designed to capture complex patterns and features related to cannabis diseases and offers a robust framework for accurate classification.The deploymentphase focuses on real-world usability and emphasizes optimization for real-time processing and scalability. Ethical considerations and user feedback mechanisms are integrated into the design, promoting transparency and trust. Overall, the project proposal aims to provide a comprehensive and affordable solution that contributes to effective disease management in cannabis cultivation.

6. EXPERIMENTAL RESULTS

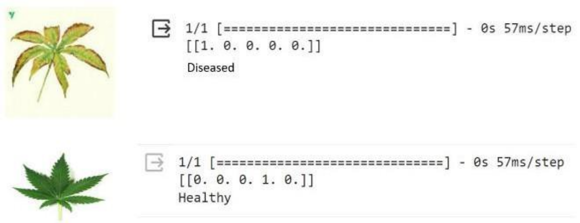

Figure 3 Model Input and Output

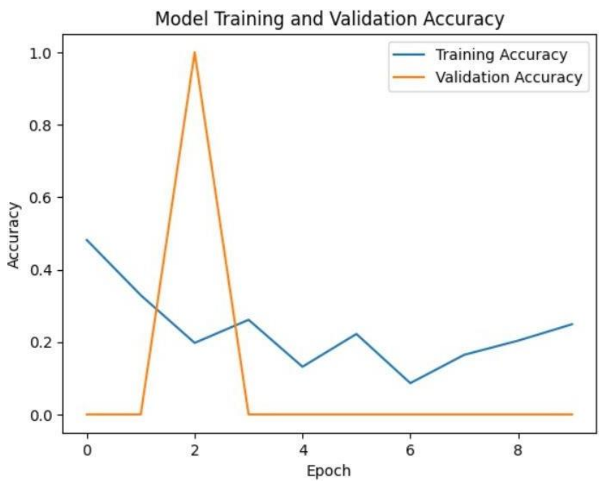

Figure 4 Model Training and Validation Accuracy

7. CONCLUSION

The project implements a Convolutional Neural Network (CNN) using TensorFlow and Keras for image- based classification of diseases in cannabis plants. The CNN architecture is designed with convolutional and pooling layers followed by dense layers for classification. Data augmentation is included during training to increase the robustness of the model. The model is trained using ImageDataGenerator and evaluated on a test set, demonstrating its accuracy in classifying cannabis diseases. The project concludes by saving the trained model for potential future use, demonstrating the effective use of machine learning techniques for image-based agricultural disease detectionin the context of cannabis cultivation.

8. FUTURE ENHANCEMENTS

In addition, this project can be implemented in all applications as embedded software.

Multi-Class Classification: Extend the model to handle a wider range of diseases by increasing the number of classes. This allows for a more comprehensive identification and classification of various cannabis plant diseases.

Real-time monitoring: Implement a real-time monitoring system to identify diseases in cannabis cultivation. This could include continuously analyzing images from the field and providing immediate feedback to farmers.

User Feedback Mechanism: Establish a user feedback mechanism to collect information on forecast accuracy and user satisfaction. This feedback can help to improve and refine the model.

9. REFERENCES

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