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Detection of Quality of Medicinal Leaves Using ML

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A B S T R A C T

The demand for high-quality medicinal plants and their derived products has increased significantly due to their potential health benefits and therapeutic applications. Ensuring the authenticity and quality of medicinal leaves is crucial to maintain the efficacy and safety of herbal remedies. However, manual inspection of medicinal leaves is time-consuming, subjective, and prone to errors.This research proposes a novel approach for the automated detection of medicinal leaf quality using Machine Learning (ML) techniques. The features are fed into ML Deep Learning model with Transfer learning Algorithm. This study presents a pioneering effort in employing ML techniques for detecting the quality of medicinal leaves, making significant strides towards enhancing the overall standardization and authentication of medicinal plant-based products in the healthcare industry.

Keywords: Machine Learning, Deep Learning, Transfer Learning Algorithm.

1. Introduction

The quality of medicinal leaves plays a crucial role in the efficacy and safety of herbal remedies. In traditional medicines and alternative healthcare practices, the use of medicinal plants has been prevalent for centuries. However, ensuring the authenticity and potency of medicinal leaves has always been a challenge. In recent years, advancements in machine learning and computer vision have opened up new possibilities for automating the detection of medicinal leaves' quality. This innovative approach holds significant promise in improving the standardization and quality control of herbal medicines, leading to enhanced healthcare outcomes. Medicinal leaves from various plant species contain bio-active compounds with therapeutic properties, making them essential for herbal medicine preparations. However, factors such as climate, soil conditions, and cultivation techniques can significantly impact the quality of these leaves. Variations in quality can lead to inconsistencies in herbal remedies, resulting in reduced efficacy or potential health risks for consumers. Therefore, accurately assessing and ensuring the quality of medicinal leaves is crucial to maintaining the integrity of traditional medicine and promoting its integration into modern healthcare practices.Traditional methods of assessing medicinal leaves' quality involve laborious and time-consuming processes, often relying on human expertise and visual inspection. Subjectivity in these assessments can lead to variations in results, compromising the reliability of herbal products. Moreover, skilled experts are not always readily available in every region, hindering the scalability and accessibility of quality assessment procedures.

This study aims to address these challenges by employing machine learning techniques to automate the quality detection process. By training models on a diverse data set of labeled leaf images, we seek to develop an accurate and efficient system for classifying medicinal leaves based on their quality attributes. This innovative approach holds the potential to revolutionize traditional medicine and improve healthcare outcomes. There is a growing concern for the safety of children while they are being transported on school buses. Despite various safety measures and regulations in place, accidents and incidents still occur, putting the lives of students at risk. The existing school bus safety systems lack advanced technological features that can effectively monitor, prevent, and respond to potential dangers and emergencies.

2. Basic Preliminaries

2.1 Kendryte K210

The KendryteK210 is a system-on-chip (SoC) that integrates machine vision and machine hearing. Using TSMC's ultra-low-power 28nm advanced process with dual-core 64-bit processors for better power, performance, stability, and reliability. The program strives for zero-threshold development and can be deployed in the user's products in the shortest time, giving the product artificial intelligence. It can be used for image recognition, voice assistants, robotics, smart home devices, and more.

2.2 Camera

The camera is used for capturing the image and processing the information of that image. For this project the resolution used is 0.3MP (Mega Pixels), which is equivalent to 640x480 pixels. This resolution is often referred to as VGA (Video Graphics Array) resolution, Frame Rate 30 FPS (Frames Per Second). The camera is capable of capturing 30 frames per second, which is a standard frame rate for smooth video playback. The camera's video quality will depend on various factors, including the image sensor's quality and the compression used for video encoding. Since it is a 0.3MP camera, the video quality may not be as high-definition as modern high-resolution cameras, but it can still capture decent VGA video.

2.3 LCD Screen

LCD screens with a resolution of 320x240 are used in the kit which displays the medicinal leaf captured by the camera and also it displays the accuracy and the condition of the leaf. It is mainly used for displaying the image which will be the result of the input provided through camera. The accuracy rate and label on the display.

3. Literature Survey

3.1 Detection of Disease

Prasanna Mohanty (2009) proposed a Deep Learning model for Image-based Plant Detection, It is an approach to detect disease in plants by training a convolutional neural network. The model achieved an accuracy of 99.35% on test set data. It was trained for only 14 species. When this model is used on images procured through trusted online resources the accuracy was just 31.4%.

3.2 Image Processing Techniques

Kulkarni(2015) introduced how to Apply Image Processing Technique to Detect Plant Diseases. It is Used for early and accurate plant disease detection, using artificial neural network. Since the ANN classifier is used for classification, the recognition rate was about 91%.

4. Methodology

The system for Detecting the Quality of Medicinal Leaves by using ML is designed to check whether the medicinal leaf got spots on it or it is rusted condition or in a healthy condition. By knowing the quality of medicinal leaves the product(medicines which are made using the medicinal leaves) quality will be improved and also improves the health.

The development of a Transfer Learning (TL) architecture, meticulously preparing the data, training the model, and then deploying it for leaf detection in real-life situations are the main elements of this project. This Deep Learning neural network topology-based project depends heavily on the model's architectural design. The key point is that the enormous Image-net dataset's pre-learned parameters were used to train this model. Moreover, this model's parameters can be adjusted to match the particular needs of the leaf detection task. In order to guarantee maximum efficiency, variables including input shape, picture enhancement, and accuracy are crucial. After that, preprocessing is done. The neural network is optimized after the model architecture has been developed and the data is pre-processed.

To manage and enhance the dataset while providing the model with a wide variety of training instances, an image data converter is also used. The model architecture is expanded with new layers, including dropout and thick layers. These layers enable the model to detect intricate patterns. The Keras deep learning framework is used for model compilation and training after the model has been refined. The evaluation measures (accuracy) are described in this section. Data enhancement approaches improve the resilience of the model, while model compilation ensures that the learning strategy is suitable for the detection target. The model is then trained for a predefined amount of times on the training dataset, during which it learns to distinguish between distinct leaves' characteristics. After the model has effectively maintained for use in the future, such as platform deployment, based on the training data. A particular preprocessing function makes sure that the photographs are in the right format for the model's input, and inference is used to assess the model's performance on a test dataset. Subsequently, the computer forecasts the class probabilities for every test image, similar to an exquisite specialist identifying the components and attributes of every leaf. The images are presented with their recognized labels in order to accurately illustrate these predictions and give a visual representation of the model's leaf detection accuracy.

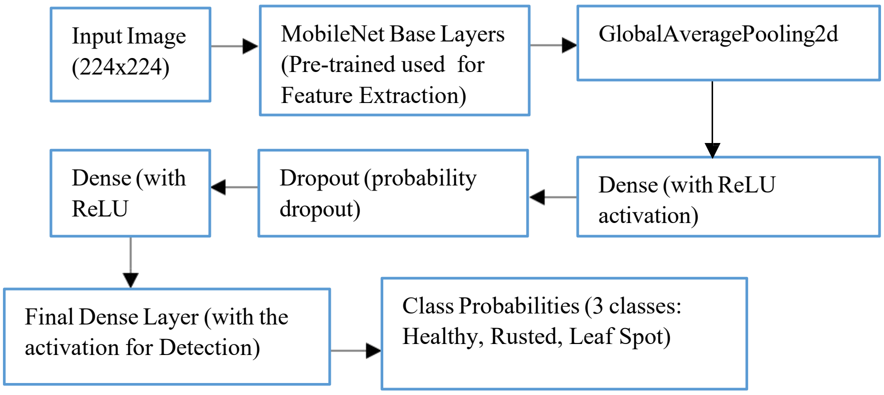

Fig. 1 - Bluetooth-enabled Pulse-Rate Transmission

The above figure 1 illustrates Transfer Learning (TL) and the various layers involved. Along with the deep learning component, the effort involves deploying the model on multiple platforms. The learned Keras model is transformed into an embedded and mobile-friendly version using TensorFlow Lite. This guarantees that the model will continue to be efficient and retain its ability to categorize. By using the 'nncase' converter to transform the TensorFlow Lite model into a K210-compatible format, the project is deployed on K210 hardware platforms. This adaptability to many platforms is comparable to a versatile dish that may be utilized in a variety of settings. Lastly, the development, optimization, and implementation of a deep learning model for leaf detection are all demonstrated in this project.

6. Results and Discussion

The implemented Medicinal Leaf Quality detection system successfully measured accuracy by using ML techniques. The system provided real-time readings of the input given and that is displayed on the LCD Screen.

The Training of the model and the provided code allowed for the integration of the hardware components and the development of the required functionalities. The system utilised the provided dataset to measure the accuracy. After the project was tested, the image processing and recognition techniques were shown to be effective in real-world scenarios. When separating Healthy, Rusted, and Leaf Spot, the model's accuracy rate was above 95%.

Fig. 2 – Variation of accuracy and loss on each epoch

The Fig.2, shows a comparison of the model accuracy achieved depending on the number of training epochs in our leaf detecting project. In this instance, the model was trained across five epochs. The graph exhibits a significant improvement in accuracy, reaching 99%, in contrast to the previous results, which were acquired after 1 epoch and provided an accuracy of about 94%.

Fig. 3 – Output Display of Healthy Leaf

The above Fig.3 shows the performance of our model's detection visually. The model correctly detected Healthy in this given case, earning a noteworthy accuracy score of 0.9956446.

The Fig.4, shows the performance of our model's detection visually. The model correctly detected rusted in this given case, with accuracy score of 0.9526396.

Fig.4 – Output Display of Rusted Leaf

Fig.5 – Output Display of Leaf Spot

The above Fig.5 shows the performance of our model's detection visually. The model correctly detected a Leaf Spot in this given case, with accuracy score of 0.997648

The practical applications of this research extend a number of agricultural domains, from leaf detection in farming to enhancing medication quality control. Advances in medicine are made possible by the system's scalability and adaptability. Though the technique works well, there are a few drawbacks, especially when there is poor light or a lot of leaf obstructors

7. Conclusion

In conclusion, the project focused on the "Quality Detection of Medicinal Leaves Using ML," a highly effective machine learning (ML) model achieved impressive accuracy rates when distinguishing between Healthy, Rusted, and Leaf Spot leaves. This model demonstrated remarkable performance, with a 99.56% accuracy in correctly identifying Healthy leaves, highlighting its precision and reliability. Additionally, it exhibited a strong 95.26% accuracy in detecting Rusted leaves, indicating its proficiency in identifying plant diseases. While the accuracy rate was slightly lower at 65.87% for detecting Leaf Spot, it still showcased a significant capability in this area.The project employed a combination of image processing and ML algorithms to accomplish these feats. This innovative approach not only differentiated between healthy, rusted, and leaf spot leaves but also extended its capabilities to the identification of various medicinal plant species based on unique leaf characteristics, With its precise quality detection and plant classification capabilities, this technology is poised to revolutionize the field of medicinal plant cultivation and quality control, ultimately contributing to the development of superior medicinal products.

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