Rushabh Prajapati

Assignment 6

Abstraction

PSYC 315 Computational Thinking

Plant diseases and pests are essential factors determining the yield and quality of plants and can cause a periodic outbreak of diseases, which leads to large-scale death and famine. Plant diseases and pests' identification can be carried out utilizing digital image processing.

Automatic detection of plant diseases may prove benefits in monitoring large crops fields and thus automatically detecting the conditions from the symptoms that appear on the plant leaves.[1] which enables machine vision that is to provide image-based automatic inspection, process control, and robot guidance. Comparatively, visual identification is labor-intensive, less accurate, and can be done only in small areas. This paper tries to provide an abstracted problem comprehension that can be used as a basis for identifying plant's leaves, stems and finding out the pest or diseases symptoms of the pest.

Earlier techniques using pattern recognition helped show a pattern for a specific disease but failed to distinguish conditions that produce similar results. Further steps like data collection, cleaning up the noise from data, examining similarities can be eliminated, observation of data patterns for related features can be minimized, and a more generalized grouping of data segmentation can be achieved by abstraction. Compared with more than 14 million sample data in ImageNet datasets, the most critical problem facing plant diseases and pests' detection is the problem of small samples.[6] Although pattern recognition solves the problem of image categorization based on the disease, it would require a more extensive dataset to achieve enhanced accuracy. Moreover, pattern recognition cannot clarify why an object, or a specific pattern was identified.

To arrive at an abstracted comprehension for the problem of detecting plant diseases from images is a complex task, as there is no single generalized algorithm or a methodology available for the recognition of plant diseases present on leaves and stems. However, we have specific algorithms and methodology from which ideas could be obtained to arrive at the abstracted version of automated identification of plant diseases.

An image processing algorithm can be used to detect the visual signs of plant diseases. The algorithm's accuracy can be tested by comparing the images, which were segmented manually with those automatically segmented by the algorithm. Image processing stays the same for almost all the detection techniques. Disease Detection can be generalized by using the SIFT algorithm, as it enables the recognition of plant species based on the leaf shape correctly; using the Support Vector Machine (SVM) classifier can help identify normal and diseased leaves[2].

Image segmentation is applied to simplify the illustration of the image with segments that can be easily analyzed. Image segmentation is performed to separate the disease-affected and unaffected portions of the leaf. K-Means clustering method is used for partitioning images into clusters in which at least one part of the cluster contains an image with a significant area of the diseased part. The k-Means clustering algorithm is applied to classify the objects into K classes according to a set of features.[8] For images with a complex background, feature extraction and classification can be done using color imagery. The color imaginary transform, color co-occurrence matrix, feature extraction will be done and get an efficiency output with a neural network; Backpropagation gives efficient groundnut leaf detection with a complex background; in this work, we classified only four different diseases with 97 Al % of efficiency. But in the future, the work will carry out more diseases by using this method.[2]

The main aim of the proposed work is to provide inputs to an autonomous Data Distribution Service (DDS), which will provide necessary help to the farmers as and when required over the mobile. This system will aid the farmer with minimal effort. The farmer only needs to capture the image of the plant leaf using a mobile camera and send it to the DSS, without any additional inputs[2]

The information included several datasets containing individual images of different leaves, existing indices for identifying specific plant diseases, and applications for identifying and classifying healthy and diseased plants. There needs to be a sufficient amount of data for the training/testing process and labeled data (healthy, not healthy). The amount of leaf damage and coverage of the illness can affect the accuracy of classified leaves as healthy or diseased. Extreme disease damage can affect the appearance of leaves so detrimentally that they may not be counted as plant material at all. [11] Due to similar patterns, those above changes are difficult to be distinguished, which makes their recognition a challenge, and earlier detection and treatment can avoid several losses in the whole plant. A plant disease is an alteration of the original state of the plant that affects or modifies its vital functions. A sign of plant disease is physical evidence of the pathogen, whereas a symptom of plant disease is a visible effect of disease on the plant.[8] Symptoms may include a detectable change in color, shape, or function of the plant as it responds to the pathogen.

The problem of accurate detection and diagnosis of plant disease by autonomous systems can vary according to each plant, as the same disease can have different symptoms for another plant. The lack of crop information may seem to affect an algorithm's ability to recognize conditions with a very similar visual appearance. Diagnosis is primarily based on characteristic symptoms expressed by the diseased plant symptoms or visible signs of a pathogen. Identification of the pathogen is also essential to diagnosis.[10] Three steps involved in diagnosis include:

- Careful observation and classification of the facts.
- Evaluation of the facts.
- A logical decision about the cause.

A somewhat abstract term for "where all the magic happens," here, the black box signifies what will happen when an image is received by it. In the current scenario, a black box technique can indicate anything because of the vast methods used by different users for detecting various diseases. Each method used for a particular diseased plant leaf works well and yields highly accurate results but, that technique for another plant turns out to be less accurate.

For an automatic disease detection system, the blackbox will have the following generalized steps:

- ➔ Image Acquisition
- ➔ Image Preprocessing

- ➔ Image Segmentation
- ➔ Feature extraction
- ➔ Identification
- ➔ Classification

As seen with Pattern Recognition, various patterns can be generated for all these six steps. To further illustrate the blackbox, when a query is made in the form of an image to the system, the image acquisition phase is more of an input phase where the end-user can query the automated system for knowing the type of disease. Secondly, image preprocessing involves various techniques such as smoothness, removal of noise, image resizing, image isolation, and background removing for image enhancement.

Thirdly, for image segmentation, the process of dividing an image into various regions, each of which is used to extract useful information, can be done based on two intensity value properties, one is discontinuity, and the other is similarity,

- ➔ Discontinuity [Edge Based]
- ➔ Similarity [Region Based, Clustering, Threshold]

Feature Extraction plays an essential role in identifying an object, and it can be based on color, texture, morphology, etc. The features are used to uniquely identify the disease name and its severity.

Lastly, classification, a blackbox inside the blackbox, uses neural networks for the final output generated by the blackbox and gives it to the end-user. However, a potential issue with using such sophisticated neural networks, a.k.a "black box" techniques, is the lack of physiological insight into why a particular model or neural network makes a specific classification.

As well as detecting the presence of disease, another avenue of research is to distinguish between different diseases to identify specific pathogens[11]; along with that, we may also need an adequate amount of disease or its severity. There are several labeled training samples required for end-to-end learning in deep learning, which is inherently opaque and difficult to interpret. The use of prior knowledge of brain-inspired computing and the use of human-like visual cognitive models in guiding the training and learning of the network is also an area worth exploring.

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