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A Study on Disease Detection Methods in Sugarcane Plants Using Conventional Neural Network and Recurrent Neural Network

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Abstract: The primary source of both sugar and ethanol, sugarcane is an essential crop in the globe. One issue facing the sugar business is sugarcane illnesses, which cause growing crops infected with the disease to be eradicated. If these diseases are not treated and diagnosed early, small-scale farmers would suffer financial losses. The reason for undertaking this study was the rapidly expanding categories of diseases and farmers' insufficient knowledge of disease diagnosis and recognition. This issue can be resolved by using deep learning techniques to computer vision and machine learning. Using 13,842 sugarcane picture datasets with disease-infected and healthy leaves, this study trained and tested a deep learning model that achieved a 95% accuracy rate. The aim of the trained model was fulfilled by. so, finally I, take the research to CNN and other CNN model.

Keywords: sugarcane leaf disease recognition, deep learning, image classification, convolutional neural network

1. Introduction:

If diseases are not identified in time, they can have a negative economic impact on sugarcane output and yield, which is a major source of concern and threat for farmers. If these crops are not grown as much, it will be bad for the economy. When it comes to the management of input resources like seed, water, soil, and fertilizers, sustainability of output is crucial. If these crops sustain harm while growing, agricultural production and

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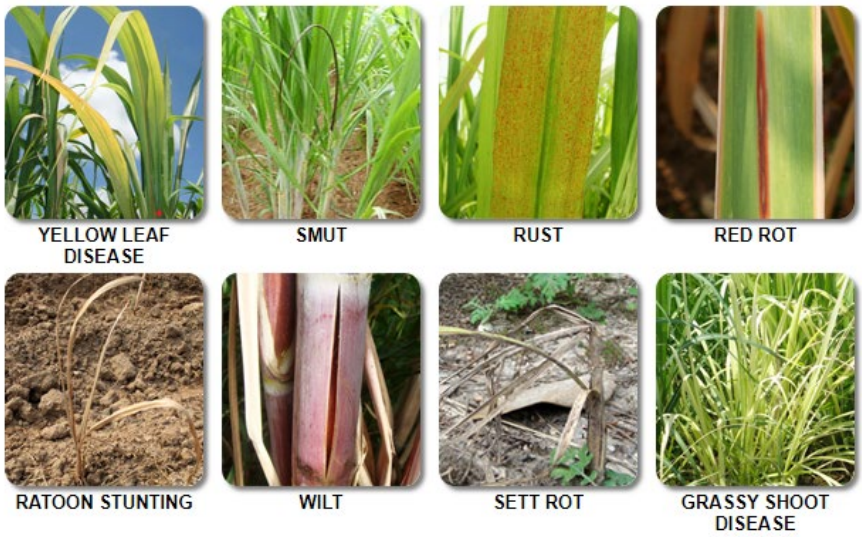
preservation will become less flexible in the competitive market. The identification and diagnosis of sugarcane illnesses has been essential in determining their avoidance. India is ranked second in the world and is one of the major producers of sugarcane. The cultivars and sowing timing determine the sugarcane cropping season and duration. India is first among sugarcane growing countries in terms of area before (3.93 mph) and second in production (167 m.t). Despite a significant rise in yield per hectare, our country's sugarcane productivity remains lower than that of other countries. Long-term crops confront a variety of abiotic challenges such as water scarcity, temperature fluctuations, floods, nutritional lag, and alkalinity. Photoplasma-induced fungal diseases such as brown spot, wilt, rust, red rot, and smut, as well as viral diseases such as sugarcane streak mosaic, sugarcane mosaic virus, and yellow leaf syndrome, have a significant impact on production. As a key cash crop in India, it leads the list by serving as feed for live livestock, fuel, and organic stubble and roots.

2. Sugarcane plant diseases

2.1 Type of diseases



2.1.1 Ratoon Rot Diseases (from July till September)

The young leaves turn light yellow or white in the beginning, then rots and finally falls down. This disease appears in the rainy season and adversely affect the growth.

A. Symptoms:

- The impacted canes show a change in leaf color in the third or fourth leaf, going from green to orange and finally yellow.

- If the fungal spores reach the leaf sheath through the leaf midrib, reddish patches will also appear on the rear side of the leaf midrib.
- After that, the leaves begin to dry from bottom to top.
- It takes an additional 10 days for the entire cane to dry out following infection, and external symptoms do not show up for another 16 to 21 days.

- The inner part of the affected cane is reddish in color with periodic white tinges throughout the cane length;

When the affected cane is split open, the pith inside it occasionally contains a blackish-brown liquid and smells like alcohol.

B. Pathogen:

- Glomerella tucumanensis is the fungus that causes red rot disease. Colletotrichum falcatum is an older name that some pathologists still favor.

Pathogen on leaf sheaths and blades; solitary or aggregated; frequently forms short lines between vascular bundles; globose, submerged; dark brown to black, 65–250 µm in diameter; wall up to 8 cells thick; ostiole somewhat papillate, circular; sclerotia on the outside, pseudo parenchymatous within.

C. Prevention

- Make sure the nursery's chosen field has adequate water drainage set up to prevent water logging during the rainy season.
- Apply 2.5 kg of Trichoderma along with 75 kg of manure per hectare.
- For every hectare, combine 100 kg of dung manure with 2.5 kg of Pseudomonas florescence.

2.1.2 Eyespot:

The eyespot disease in sugarcane is caused by Helminthosporium sacchari. It matures in six to seven months and is more prone to illness. Lesions appear as tiny, initially water-soaked patches that jut out more into the surrounding tissues. Foliar's 0.3% Mancozeb or 0.2% copper oxychloride applied in two or three sprays over a period of

ten to fifteen days can lessen the illness. Depending on how serious the illness is, spraying should be done. Visit [https://plantvillage.psu.edu/topics/sugarcane/infos] to learn more. Another illness brought on by Xanthomonas albileneans is leaf scaling. There are various successful ways to manage this illness. Breeds that are resistant to disease can be obtained from nurseries and raised. Sets that have undergone a long hot water treatment or a cold soak can be used to develop these cuts. After After three hours of hot water treatment at 50°C, the cuttings are left to soak in cold running water for 48 hours. [Pathway/Sugarcane/Titbits/Info's/PlantVillage.psu.edu].

2.1.3 Yellow Leaf:

The Sugarcane Yellow Leaf Virus (SCYLV) is the cause of sugarcane yellow leaf.During the monsoon season, the yellowing spreads from the leaf midrib over the leaf blades until a broad yellowing of the leaves is visible from a distance.[Aruna Devi, 2016]. Increasing the number of breeds with varietal resistance is the most effective way to prevent sugarcane diseases. The development of this disease in crops is hampered by the lack of information in selecting genetic yellow leaf resistance breeds. [Viswanathan and Rao,2011].

A. Symptoms:

- The five to six-month crop is impacted by this illness.
- Midrib and nearby laminar region yellowing as well.
- The subsequent drying of three to five leaves starting at the top along the midrib.
- Drying of the spindle and leaves in extreme situations; in few cases, reddish discoloration is also observed.
- Cane growth is stunted, especially the internodes, which are afflicted;
- The illness may be identified from a distance.
- In extreme cases, the top of the cane may seem bunchy.
- This disease spreads rapidly in mature cane.


Yellowing of leaf


Yellowing of midrib


Drying of leaf

B. Pathogen

- Aphids, Melanaphis sacchari and Rhopalosiphum maidis, are the semi-persistent carriers of the virus. SCYLV belongs to the family Luteoviridae. The virus is restricted to the plant's phloem cells.

Melanaphis sacchari

Rhopalosiphum maidis

2.1.4 Red Rot:

Third and fourth leaves from the top start drying and red or brown lesions appear in the mid rib of the leaf. When the cane is cut vertically, the soft tissue appears reddish which emits an odor like vinegar. White or brown colored fungus develops in pith of the sugarcane.

Red rot is a fungus disease brought on by Colletotrichum falcatum Wentis. Leaf scars, pinkish porulation at the rind, and dull red to brown hues on the rind and nodal regions are all obvious indicators of a serious crop infection. The leaves can be treated by dipping them in 0–1% carbendazim (Bavistin) for 15–20 minutes. Prior to planting main and general cane, this should be completed. Spraying needs to be done as soon as the disease starts to spread. Major diseases: [https://sugarcane.icar.gov.in/index.php/en/2014-04-28-11-31-50]

Identification

Prevention

- Use a cultivar resistant to illness. Don't use setts with nodes that have been cut off if redness is visible.
- Plant healthy sugarcane setts that have been treated with the moist hot air method (2.5 hours at 54°C and 99% humidity).

- Make sure the nursery's chosen field has adequate water drainage set up to prevent water logging during the rainy season.
- Apply 2.5 kg of Trichoderma along with 75 kg of manure per hectare.
- Apply 100 kg of dung manure and 2.5 kg of Pseudomonas florescence per hectare.

2.1.5 Mosaic:

The Sugarcane Mosaic Virus (SCMV)/Sugarcane Streak Mosaic Virus (SCSMV) is the cause of the mosaic illness. It may be successful to rogu the affected plants in order to eradicate SCMV. Incorporating inoculum pressures, a control measure, are not expressive among the use of mosaic- free seed canes. Planting material thermo-therapy may result in SCMV-free among some plants. The creation and use of resistant clones dominated the mosaic in sugarcane for a long time. [Devi Aruna, 2016].

2.1.6 Ringspot:

It is caused by the fungus Leptosphaeriasacchari. Tiny, elongated, oval-shaped spots turning from dark olive green to reddish-brown with thin yellow halos, are the initial signs of a ring-spot. Spots are frequently noticeable on the stems and leaf sheaths. The plant's elder leaf blades are typically the most damaged. The yield is significantly improved by calcium silicate slag and soil amendments, which also lessen the intensity of ring spots.

3. Image processing Technique in sugarcane

The diseased leaf of sugarcane is acquired and through image pre-processing technique where the unwanted image data are suppressed. The image is enhanced through AHE. Then, the process of segmentation is done through Adaptive k-Means Clustering. The desired features are extracted by using GLCM and PCA.

a) formatting the image computation/fellow/3clumn
b) preprocessing in sugarcane i/p image avg filtering media filtering
c) sugarcane image analysis

1) Adaptive Histogram Equalization:

Adaptive histogram equalization (AHE) is a computer-ized image preprocessing technique used to get a high improvement in contrasting the images. This technique creates many histograms, each of which represents a different area of the image. Redistribution is then carried out in accordance with the tone of the image. Therefore, it helps in the enhancement of edges and in the improvement of local contrast of an image.

2) Adaptive k-Means Clustering:

k-means clustering is an algorithm that comes under the unsupervised learning group. The primary intent of this k–means clustering algorithm is to construct k number of groups based on similar features. Consequently, a centroid is selected for every cluster to provide fresh label data, which is then trained. Rather than splitting groups apart without considering the data, this algorithm assists in locating and analyzing the groups that have developed naturally. The centroid weights provide insight into the type of group that each cluster designates [Jagan et al., 2016]. Rehearsal refinement is the algorithm used to produce the output. The number of data sets and the clusters k are the algorithm's inputs. The algorithms starts with the estimation of the k centroids and then repeats between three steps: Data Assignment, Centroid Update and Choosing k.

3) Feature Extraction:

Analogous to dimensionality reduction, feature extraction is the process of extracting the informative features. When there is duplicated information or when the input data is extremely large, feature extraction is employed to decrease the amount of data. The feature extraction stage of a character recognition system often comes after the pre-processing stage [Reddy et al., 2017]. Finding the initial feature subsets is all that feature selection entails. Since the classifier is unable to distinguish between the badly chosen features, this is the most crucial step in the entire process. It also aids in obtaining improved performance.

4) Gray-Level Co Occurrence Matrix:

It is one of the statistical methods for analyzing texture. It is also known as the gray-level spatial dependency matrix and deals with the spatial interaction between pixels. It is desirable to have a higher average matrix occupancy level when estimating the joint probability distribution. This is achieved by restricting the number of amplitude quantization levels, which may result in a reduction in low-amplitude texture precision. According to Reddy et al. (2017), each element (i,j) in the generated GLCM (where j stands for the pixel value and i for the intensity value) represents the total number of times the pixel with value i that occurred in relation to the pixel of j. The input image is scaled by the gray co-matrix, which is an expensive process. [Devi Aruna, 2016].

5) Principal Component Analysis:

PCA is a kind of statistical method which creates new un-correlated variables known as principal parts using orthogonal transformation. The ensuing vectors are the unrelated set of orthogonal basis. PCA is susceptible to the relative size of the initial variables. PCA is performed by eigenvalue decomposition of an information variance matrix or singular worth decomposition of an information matrix. Every attribute is standardized by mean centering such that its empirical mean value is zero. The nonstandardized attributes are eigen vectors. They are the cosines of orthogonal rotation of variables into principal elements or back [B.Chitradevi, P.Srimathi,2014].

6) Classification:

Classification deals with the wide range of decision-theoretic approaches for image identification. The image in question has one or many features and these classification algorithms helps in classifying the image to one of the distinct classes based on the features. The classes are specified in prior by the analyst [Shweta and Shandilya,2018]. The different types of well-known classifiers are Support vector machines, Quadratic classifi-ers, Linear classifiers, Learning vector quantization, Kernel estimation, Neural networks, and Decision trees.

7) Support Vector Machine:

It is one of the wellsuited algorithm for image classification. To classify the images remotely, Kernel based image classification is mostly used. SVM with multiple kernels is used for the classification of images with kernel optimization. Feature extraction is an important process that must be carried out before classification, because the images are categorized on the basis of the extracted features. SVM Kernel method provides a good solution for regression and classificationbased problems. This is a supervised machine learning algorithm and the two different classes are separated by a hyperplane. If the classes are separated with the larger margin, then it has minimal error. The minimum error is used to predict the correct class of the data without any error in the classification process [Chitradevi, P. Srimathi,2014]. There are two parallel planes called "Boundary planes" and the distance between these two planes is known as 'margin'. The points that lie on the boundary planes are called 'support vectors' [Shweta and Shandilya,2018]. It is one of the best and popular method used for image classification.

Results And Discussion

The diseased leaf of sugarcane is acquired and through image pre-processing technique where the unwanted image data are suppressed. The image is enhanced through AHE. Then, the process of segmentation is done through Adaptive k-Means Clustering. The desired features are extracted by using GLCM and PCA. Finally, the classification of diseases is done through SVM. The above described process is executed in MATLAB software and the obtained results for six sugarcane diseases are shown in figures from 5 to 10.

Conclusion

In present situation, it is difficult for farmers to keep an eye on each plant in the growing area and detect the manifestation of any infection. To serve the function of a

watchdog by detecting the disease and determining the form of the disease in the leaf, image processing techniques have been developed. The combination of various feature extractions (GLCM and PCA) with SVM classifier has been implemented to test six signifi-cant diseases which largely affect the sugarcane yield. The proposed system achieved the ac-curacy value of 95%. A detailed review of the causes and symptoms of all sugarcane diseases is highlighted in this article. The web application developed for our system is targeted for the farmers to apply it. It will benefit them with desirable solutions within a short span of time. As a future work, various classification methods can be tried to increase the efficien-cy of the system in which and the system can be improved by a broader data set for the identification of all forms of sugarcane diseases. For the web application part, the information can be made available in the regional language.

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