Chapter 13
Sugarcane Disease Detection Using Data Augmentation

Abhishek Verma
https://orcid.org/0009-0002-2417-047X
Centre for Advanced Studies, Lucknow, India

Jagrati Singh
Indira Gandhi Delhi Technical University for Women, Delhi, India

ABSTRACT

Sugarcane is an important crop for the Indian economy, providing employment opportunities for millions of farmers. Nevertheless, the cultivation of sugarcane faces challenges from pests and diverse diseases. The detection and segmentation of plant diseases using deep learning have shown promising results in simple environments with abundant data. However, in complex environments with limited samples, the performance of existing models suffers. This study introduces an innovative method that addresses the challenges of complex environments and sample scarcity, aiming to enhance disease recognition accuracy. The highest accuracy showcased by model is 98% on testing data. Comparative study was done on the same dataset by employing various ML algorithms and achieved the highest accuracy of 70%. An Android app has been created to serve as the user interface for this model. This app enables farmers to either take pictures using their phone's camera or choose images from their gallery.

INTRODUCTION

India ranks as the second-largest sugarcane producer globally, following Brazil (Sakshi Srivastava et al., 2020). Sugarcane holds significant importance as a crop cultivated across numerous tropical and subtropical regions worldwide (Viswanathan et al., 2011). It is used to produce sugar, ethanol, and other products (Elsharif et al., 2019). However, the crop is susceptible to a wide range of diseases that can cause significant yield losses. Several common diseases can affect sugarcane as shown in Figure 1, including Red rot, which is a fungal infection caused by Colletotrichum falcatum (Ruchika Sharma and Sushma Tamta, 2015). This disease primarily targets the sugarcane stem, resulting in

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reddish-brown lesions that darken over time, often turning black. Infected plants typically exhibit stunted growth, wilting, and premature death. Red rot thrives in warm and humid climates and can rapidly spread through contaminated plant debris, soil, and water. Another notable disease is Red rust, caused by the fungus Puccinia melanocephala. This disease predominantly affects sugarcane leaves, manifesting as orange-red rust pustules beneath the underside of the leaves. Red rust can hinder photosynthesis, leading to leaf yellowing and shedding, ultimately reducing cane yield. It tends to be prevalent in humid tropical regions and spreads through wind, water, and human activities. Lastly, Bacterial blight, induced by Xanthomonas albilineans (Rakesh Yonzone et al., 2018), affects sugarcane leaves by creating yellowish-white streaks that gradually turn brown. This disease can disrupt photosynthesis, resulting in stunted growth and reduced yield. Bacterial blight thrives in warm and humid environments and can spread through infected planting material, sap, or insect vectors. These diseases collectively pose significant challenges to sugarcane cultivation and necessitate vigilant management strategies. The occurrence of diseases in sugarcane plants poses a substantial challenge and risk to farmers, leading to economic repercussions by affecting both yield and production (Apan et al., 2004). Timely detection is crucial to mitigate these impacts. A decline in the cultivation of such crops can exert adverse effects on the overall economy. Not only the crop but fertilizers, water and seeds are also wasted (E. K. ratnasari et al., 2014). Detecting and identifying sugarcane diseases is crucial for maintaining competitive flexibility in crop production and preservation (Simon Strachan et al., 2022). However, relying solely on traditional techniques that involve naked eye observation by experts can be problematic, as they may not always be accurate and can lead to misidentification of diseases (Tisen Huang et al., 2018). Traditional methods require continuous observation which can be a laborious task and a large farm makes this task almost impossible (L. Li et al., 2021). In developing countries like India, it is costly and laborious to seek out an expert's assistance. Among the limited options at hand, machine learning techniques have been employed, but their performance often falls short of expectations, yielding merely satisfactory results. To attain enhanced outcomes, the transition to more advanced approaches, such as deep learning, becomes imperative. Deep learning has demonstrated its prowess as a leading methodology for image classification, a testament to its success across diverse domains (H. S. Malik et al., 2020). Particularly noteworthy is its effectiveness when applied to large datasets, as it has consistently delivered remarkable results. The work conducted by Sammy V. Militante et al. (2019) stands as an instance of employing Convolutional Neural Networks (CNNs) to develop a model aimed at recognizing sugarcane diseases. A dataset comprising 13,842 sugarcane images was employed for training purposes and achieved an accuracy of 95%. Wang et al. introduced a two-stage model known as DUNet, which combined DeepLabV3+ and U-Net architectures for cucumber leaf disease severity classification, particularly in challenging backgrounds. Remarkably, this approach achieved an impressive leaf segmentation accuracy of 93.27%. Adem et al. introduced a hybrid approach, combining Yolov4 deep learning and image processing, to automatically detect and classify leaf spot disease on sugar beets. With 1040 images, the method achieved a classification accuracy rate of 96.47%.

This paper presents a fresh perspective on improving the precision of sugarcane leaf disease classification by harnessing the power of data augmentation techniques. In our investigation, we harnessed a substantial dataset, consisting of 2099 images. This dataset encompasses not only three distinct categories of diseases but also includes a reference class of healthy sugarcane leaves. These images were thoughtfully curated for the purpose of training and rigorous experimentation.

(a) (b) (c) (d)

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