[1]Vishnu Prabhakar V.,

[2]Dr. N. Sudha

Identification of Banana Leaf Diseases By Using Image Filtering Algorithm

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***Abstract*:** For thousands of years, agriculture, the foundation of civilization, has kept people alive. From simple origins, it has developed into a sophisticated science that is always looking for new and creative ways to overcome obstacles and maximize production. One such frontier is the rapidly developing field of plant leaf disease detection, which is transforming the way we keep an eye on and control the health of plants. Feeding the world's expanding population is fraught with challenges, ranging from pests and diseases to climate change. Plant health is essential to guaranteeing abundant harvests in the delicate dance of agriculture. Conventional disease detection techniques, which frequently include manual scouting, can be tedious, time-consuming, and prone to human mistake. Image processing comes into play here, providing a revolutionary method for precise and early disease detection for the plants.

***Keywords*:** Image Processing, plant disease detection, filtering algorithms

1. INTRODUCTION

In addition to taking away the crops' healthy attractiveness, plant leaf diseases also steal the valuable produce that keeps us alive. These pernicious diseases, which are brought on by several bacterial, viral, and fungal pathogens, severely damage agricultural landscapes and pose a serious risk to the world's food security. Early detection is the first line of defense in this quiet fight. The secret to spotting a disease before it spreads is to have keen eyes trained on the minute changes in a leaf's color, texture, and shape. There are several indicators that a leaf is fighting an invisible foe, including wilting, browning, stains, and lesions.

The armory used to combat these adversaries is varied and incorporates both conventional and innovative techniques. While precision agriculture innovations like the use of drones and sensors give new hope for focused treatments, tried-and-true methods like crop rotation and fungicides are still essential. But knowledge is arguably the most powerful weapon in this battle. It is crucial to give farmers the tools they need to correctly identify illnesses and put appropriate management measures in place. This calls for training programs, extension services, and access to trustworthy information.

We can fight the quiet menace of plant leaf diseases by increasing awareness, promoting knowledge, and implementing creative solutions. In order to ensure not only abundant harvests but also a future when everyone has access to food, let's preserve the lush fabric of our agricultural lands.

Minimizing crop losses requires early diagnosis of plant leaf diseases. Traditional techniques frequently depend on visual inspection, which is laborious and prone to human mistake. An alternative that shows promise is image filtering algorithms, which provide increased accuracy and automation. These methods enhance minor visual indicators of disease, such as color changes, texture changes, and lesion patterns, by analyzing collected leaf photos. Diseased areas are identified and measured using methods like thresholding, edge detection, and noise reduction. Prompt actions, such as targeted pesticide application or fungicide treatment, are made possible by the ability to diagnose individual diseases or even predict their spread.

By enabling quick, reliable, and objective disease identification, image filtering algorithms enable professionals and farmers to protect their crops and guarantee bountiful harvests. A fast expanding topic that has the potential to completely transform agriculture is the application of image-filtering algorithms for plant leaf disease

[1]Research Scholar
Department of Computer Science
Bishop Appasamycollege of arts and science
[2]Associate Professor
Department of Computer Science
Bishop Appasamy college of arts and science
vishnupchittur@gmail.com
sudhanatarajan105@gmail.com

identification. We can automatically detect and categorize diseases in their early stages by examining leaf photos, which enables more rapid intervention and higher crop yields.

For the pre-processing and indentation of the diseases, the specific image of a banana leaf that is sick is taken into consideration. Using filtering algorithms like the Canny, Robert, and Prewitt filters, this research assesses the filtering algorithms for pre-processing and indentation of the disease. Typically, we concentrate on forecasting diseases of banana leaves, including Cordana, Sigatoka, and Pestalotiopsis. It might be helpful in recognizing various agricultural diseases. The MSE and PSNR values are compared to the filtered images. This makes it possible to identify the affected area. To create an effective system, this can be used with data mining techniques.

2. METHODOLOGY AND ALGORITHMS

The methodology section is divided into four stages. All phase actions must be performed in the same order in order to identify the diseased portion of the banana leaf.

i) Image Acquisition

The first note is struck by image acquisition, which records the visual environment we wish to examine. As varied as the applications themselves are the picture acquisition techniques. Conventional cameras are frequent workhorses because of their digital sensors. Other types of radiation, such as X-rays for medical imaging or infrared for night vision, can be captured by specialized sensors. While microscopes can uncover the unseen beauty of a single cell, drones can offer expansive aerial views.

The objective of image collection is always the same, regardless of the method used: to accurately capture the required data in a manner that can be processed. This entails minimizing distortion and noise while maintaining appropriate illumination, focus, and resolution. It's the pivotal initial act that establishes the framework for the exciting development of the image processing field.

ii) Image Pre-Processing

As the essential backstage staff, image pre-processing gets the raw visual data ready for the spotlight. Picture a stage that is dusty, dark, and cluttered with misplaced costumes and props. Like a talented set designer, pre-processing intervenes to turn this mess into a spotless performance area. First, filters are used to eliminate undesirable noise, such as camera artifacts or stray light leaks. Imagine it as carefully dusting the stage and looking for groaning floors. The image is then tweaked for the best contrast and lighting, such as adjusting the stage lights' brightness or dimming them to create the ideal atmosphere.

The next step is to arrange the visual components. Colors may be adjusted, such as by changing the costumes' shades to correspond with the screenplay. After removing any extraneous background components, such as props or stray chairs, the stage is clear and ready for the actual analysis to start.

iii) Image Segmentation

As varied as the applications themselves are the segmentation techniques. Thresholding divides pixels according to their intensity, much like a basic sorting system. Edge detection recognizes abrupt changes across areas, much like tracing outlines with a pen. More complex methods, such as k-means clustering, create a mosaic of unique segments by grouping pixels according to shared criteria. In order to glean valuable insights from complicated visual data, image segmentation is essential. The secret to revealing the narrative concealed in an image, one pixel at a time, is the art of organization.

iv) Feature Extraction

The main focus is feature extraction, which turns the unprocessed pixel fabric into a vivid palette of measurable attributes. Consider a master craftsman carefully inspecting a woven rug, following its elaborate designs, and determining the strands that give it its individuality. However, feature extraction is more than pixel counting. It's about encapsulating what makes a place or thing special. The roughness of an object's surface is captured by texture features, such as veins in a leaf or ripples in a pond. Its chromatic makeup is described by color aspects, such as the muted tones of a desert environment or the vivid hues of a flower. Its form is outlined by shape descriptors, such as the lengthy curves of a bird or the geometric regularity of a skyscraper.

To diagnose diseases, a variety of image processing algorithms are employed. Here, we're looking at the most well-liked one.

i) Canny Filtering Algorithm

To identify which edges really stand out, the Canny filter puts on a "thresholding cloak," employing two thresholds. Imagine it as establishing a minimal "suspect height" to weed out unimportant information. While the higher criterion guarantees that only the most confident edges make it through, the lower barrier captures weak but promising edges.

The Canny filter's multi-stage method makes it extremely effective. It suppresses noise and extraneous details while detecting crisp, distinct edges. For tasks like object detection, image segmentation, and robot navigation, this makes it indispensable. Robots can firmly grip things, self-driving cars can precisely track lanes, and medical imaging devices can clearly identify irregularities thanks to the capacity to recognize precise contours.

ii) Prewitt Filtering Algorithm

The Prewitt filter is a master craftsman that can enhance edges and bring out hidden details with the help of two delicate brushes. Due to its adaptability, the Prewitt filter is frequently used for a variety of image processing applications. It works well for motion analysis, picture segmentation, and object detection since it can identify both vertical and diagonal edges.

iii) Robert Filtering Algorithm

Like a pair of sparkling scissors, the Roberts filter quickly removes extraneous details to expose the important, crisp lines. Picture a talented tailor painstakingly cutting away extra cloth to reveal the garment's actual shape. When applied to grayscale photos, the Roberts filter treats each pixel as if it were a microscopic thread. Its scissors are two exquisite, basic 2x2 masks, one of which resembles a diagonal cut and the other of which is perpendicular. These masks compute the intensity difference between diagonally opposed pixels at each position, functioning as tiny templates.

3. IMAGE PROCESSING TOOLS

There are some tools available for Image Processing and Data Mining to process plant disease detection like MATLAB, PYTHON, etc. Here, we processed the photos using MATLAB, the most popular and effective program.

3.1 **MATLAB**

MATLAB will be a more versatile tool for image processing. It's written in Java, C, and C++. MATLAB is now utilized in all areas of computational mathematics. Include-matrix and array operations, linear algebra, algebraic equations, statistics, calculus, integration, and other mathematical computations are the most frequently utilized. Signal processing, image and video processing, control systems, computer vision, artificial intelligence, and more are just a few of the many uses for MATLAB. The most widely used program in the field of digital image processing is called MATLAB.

4. DATASET CONSIDERED

In the proposed method filtering algorithms are used to compare the efficient algorithm to achieve the identification of the banana leaf diseases and pre-processing of the images. For this, we have considered the expert dataset having banana leaves of three different types of diseases (Coradana, Sigatoka, and Pestalotiopsis). Below are the diseased banana leaves considered for the evaluation.

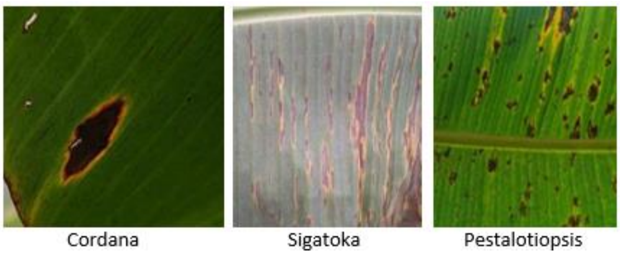
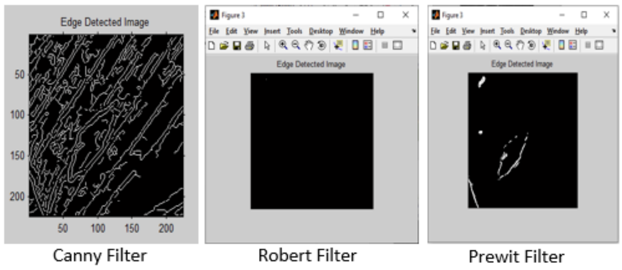


Fig (1) : Input Images

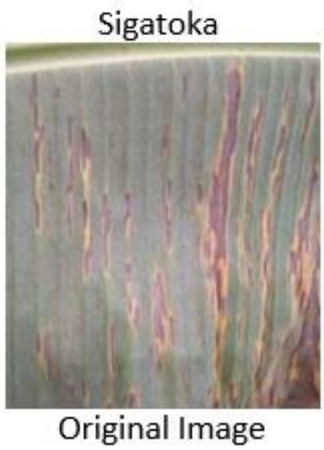
5. RESULTS AND COMPARITIVE ANALYSIS

The original images are considered for the evaluation. There are three different types of diseased banana leaves taken for this, they are namely Cordana, Sigatoka, and Pestalotiopsis.

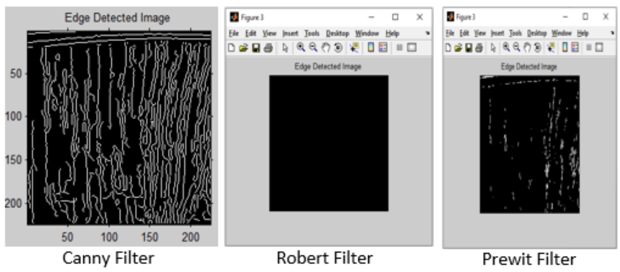
Fig(2)



Fig(2)a

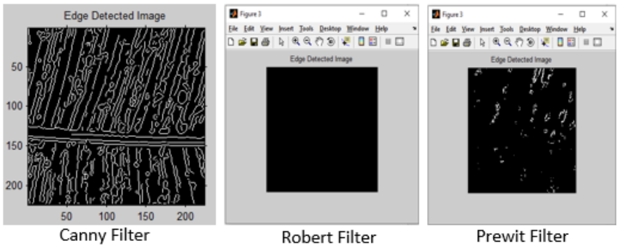


Fig(3)



Fig(3)a

Fig(4)



Fig(4)a

Fig(2) shows the original image of Cordana disease that is used for the processing and the following Fig(2) depicts the results after processing with the algorithms such as the Canny filter, Robert filter, and Prewitt filter. Similarly Fig(3) for Sigatoka and Fig(3) shows the results after processing with the filtering algorithms. Fig(4) for Pestalotiopsis and Fig(3)a shows the results after processing with the filtering algorithms.

MSE

MSE (Mean-Squared Error) offers a straightforward and efficient method for assessing differences in images, but it has its drawbacks. It considers all pixel errors the same, neglecting how humans perceive images, where some details are more important than others. Furthermore, MSE can be overly affected by noise or minor, high-frequency changes, which may lead to an inaccurate representation of the image's overall quality.

PSNR

A crucial metric in image processing for assessing how well a reconstructed image compares to the original is the Peak Signal-to-Noise Ratio (PSNR). In essence, it measures the amount of noise that has been added to the image as a result of compression or transmission.

The mean squared error (MSE) between the original and reconstructed pictures is compared to determine PSNR. The average squared difference between the corresponding pixel values in the two images is known as the MSE. A higher PSNR value and a lower MSE signify a tighter likeness between the images. Better image quality is indicated by greater PSNR values, which are commonly reported in decibels (dB).

DISEASE	MSE			PSNR		
	CANNY	ROBERT	PREWITT	CANNY	ROBERT	PREWITT
Cordana	86.3	98.5	96.8	28.8	28.2	28.3

Sigatoka	82.85	97.9	98.3	28.98	28.25	28.24
Pestalotiopsis	81.38	98.5	98.2	29.05	28.23	28.24

Experimental result shows that the MSE value for Canny Filter is lower than Prewitt and Robert. From the results it shows that the PSNR value is higher for Canny Filter. This shows that the Canny Filter is efficient than other two filters.

6. SUMMARY

By analysing the input images, we were able to determine that the image processing methods were successfully applied to segment the images and locate the banana leaf's infected area.

The four stages of the process can be completed by using the MATLAB program.

By eliminating the noise, the filtering algorithms will aid in the generation of the diseased banana leaf section. Prewitt, Canny, and Robert filtering algorithms can be applied to the filtering process. Data mining algorithms are utilized for the classification and clustering procedures in the next step. To achieve the best outcomes, data mining technologies use association, decision trees, clustering, and pattern recognition. Support vector machines (SVM), K-means, and C4.5 are popular clustering techniques. All of these efforts help to improve the results of plant disease identification. The work completed here will be followed by this scope of work.

7. CONCLUSION

In this research work, diseases of banana leaves are identified. The different image processing techniques and algorithms utilized to detect banana leaf diseases were also taken into consideration in this work. The diagnosis of diseased leaves can be effectively accomplished with a variety of image processing filtering methods. According to the evaluation's findings, the canny filtering algorithm outperforms the Robert and Prewitt filtering algorithms in terms of effectiveness. This would lessen the impact of plant diseases and help the agriculture sector become more productive. Additionally, it helps farmers identify diseases in plants early on. This will serve as a proactive step in the process of finding a cure for plant diseases.

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