



Modern image processing techniques for identifying and classifying Disease Detection in Potatoes Crop

El moubchiri chaimaa¹, Michael M. Sabugaa², Ihsan K. Jasim³, Saeed Ahmad⁴, Sulaimon Araromi Olawale⁵, Azmat Ali Noshier⁶, Zubaida Rehman⁷, Moayad Abdullah Jassim⁸

¹Higher institute of health sciences, Hassan Premier settat, Morocco

²Agusan del Sur State College of Agriculture and Technology, 8506, Philippines

³Turath University College, Baghdad, Iraq.

⁴Riphah International University Lahore pakistan

⁵College of Medicine, University of Ibadan, Nigeria

⁶Pir Mehr Ali Shah Arid Agriculture University Rawalpindi

⁷School of Computing Technologies RMIT University

⁸College of Education, Al-Farahidi University, Baghdad, Iraq

ABSTRACT

This study details the methods and processes used in a system for identifying and classifying diseases in potato crops using image processing. However, due to the diversity of diseases in the potato leaf, the system has also been applied to identify the crop's three most common types of pests. Because illnesses of Downy mildew and bacterial spot are well-known to cause harm to the plant leaf, a benefit of the detection system achieved by image processing emphasizes the need for a design for the early detection of diseases in plants. Methods for disease detection in potato leaves are outlined, including the five core phases involved in identifying and labelling an object within an image, in this case, a diseased potato leaf. In the first phase, a picture of the diseased leaf is acquired; in the final stage, an ANN (Artificial Neural Network) is used to classify the image and determine whether what kind of disease it is present in the potato crop. Finally, the processed results of the disease detection system on the potato leaf are given images via means of the Mat lab program.

Keywords: Image processing, potato crop and disease detection.

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INTRODUCTION:

Technology can be found in any scientific discipline to solve a problem or make a task more manageable. Because of its long history of mediation between humankind and the natural world, agriculture is also a sector where its use is evident. Technological progress and agricultural innovation are significant drivers of productivity gains. Agro technology is a field of study that merges agriculture with technology; it is broad in scope because it includes both of these fields. The region of kalam in the swat district has a

unique wealth of potato production techniques; the dilemma is whether or not to zero in on just one, such as the cultivation of the Al-Gaadi potato (Matheu Vasco, 2022).

Farmers in the high Andean regions have been lying. Traditional methods have evolved between 1800 and 2000 m above sea level to meet the demands of extreme weather. Optics, electronics, mathematics, photography, and computer science are all integral to the exciting discipline of digital image processing. Use this scientific classification for early detection of diseases in



the potato crop, and this detection is accurate and reliable. The farmer will have a better chance of devising an effective plan to fight off pests without resorting to potentially harmful chemicals for the tuber, the farmer, and the consumer (Prendes Rodríguez, 2021; Torres-Vite & Contreras-Liza, 2019).

MATERIALS AND METHODS:

Visual cues such as objects, colours, and edges are easily recognized by living things. This is a simple task in our world, but computer vision systems have a lot of trouble with it because they lack an artificial intelligence process that can match a human's visual perception. Typically, an object identification system aims to locate and name certain things within a given image. Numerous issues in areas as diverse as business, security, health, and robotics have been resolved by integrating multiple image processing and pattern recognition methods (Bonnet et al., 2020; LLano et al., 2018).

The detection and classification of plant diseases by image processing adhere to the same five-step method standard for object recognition and detection. Each process is crucial in identifying and categorizing objects inside images (Palomar Sanz et al., 2019).

Acquiring an Image

The camera takes pictures of plant leaves that may be analysed, stored, and sent. This is an RGB image (red, green, and blue) (Carrillo-Salazar et al., 2019; Jiménez Brenes, 2018).

Ahead-of-time manipulation of images

Cropping the image to just the afflicted area is crucial after contrast improvement, noise reduction, and feature enhancement have been done to remove any other distracting elements. The smoothing filter is used to get a more refined appearance in images. The contrast is cranked up with some help from enhancement. Consequently, plant disease photos can benefit from histogram equalization, a method that spreads grayscale intensity (Báscones García, 2020).

Cut up an image into smaller pieces

Segmentation is dividing a picture into smaller pieces that all share the same or

comparable properties. The Otsu approach, k-mean, clustering, turning an RGB image into a HIS model, etc., are just a few of the many techniques that can be used for segmentation. We see an algorithm for detecting boundaries and points in a segmentation model (Álvarez, 2018; Soria Poma, 2019).

- With the help of a limit and point detection method, the RGB image is transformed into a HIS model for segmentation (LLano et al., 2018). An observation of the contaminated area of a leaf can be located with the aid of boundary detection and point detection. Hue, Saturation, and Intensity (HSI: Hue, Saturation, Intensity) are colour attributes used in the HSI model to represent the colour, its purity, and its brightness, respectively. When it comes to aesthetics, the tone is like a favourite shade of paint. Saturation describes how well-developed or pure colour is (its degree of blending with other primary colours). Last but not least, the level of intensity is the perceived level of brightness in an image (Hemeida et al., 2019).
- Classifying things into K categories using a feature set is the goal of K-Means clustering. Minimizing the sum of squares of the distance between an object and its appropriate group is used to classify it (Giménez Aguilar, 2022; Juk, 2018).
- The Otsu threshold algorithm's main strength is that it can be used independently of any human intervention or prior knowledge of the image's context. This technique is employed when the objects to be retrieved stand out sharply against the scene's background. This strategy selects the best threshold via an exhaustive search for the maximum possible differences between classes.

Choosing a suitable multilayer threshold using Otsu's approach becomes more time-consuming as the number of classes in an image rises. By setting all pixels below a zero threshold to one and all pixels above that threshold to zero, thresholds transform grayscale images into binary images—the afflicted leaf's coloration changes due to the



disease. Infected areas of leaves can be identified by analysing the green of the photos. From an Image, we pull the R, G, and B channels. The Otsu technique is used to determine the cut-off value. The greens are masked and deleted, and the resulting pixel intensities are below the threshold (Khlebnikov Núñez) (Hemeida et al., 2019).

Determining Important Characteristics

One of the most crucial steps in object recognition is feature extraction, removing unwanted features (such as colour, texture, morphology, or edges). When looking for plant diseases, these features will be most beneficial. A picture's surface consists of its roughness and hardness, two qualities that can help identify sick plant parts using a neural network for classification in an ANN (Artificial Neural Networks) system (Moré, 2021; Piloto-Rodríguez et al., 2019).

Following feature extraction, a neural network categorizes photos from the database that will serve as training data. These feature vectors represent neurons in an artificial neural network. A neuron's output is

a function of the inputs, which are weighted sums. In this scenario, the neural network compares the input image's properties to those recorded in a database of photos of diseased leaves. It then determines to which range it belongs and what form of the disease it is most similar. The more information factored into the neural network's calculations, the more precise the outcomes will be (Mantecón del Valle, 2018).

DISCUSSION AND RESULTS:

Acquiring an Image

An analysis of the different parasites infecting Andean potato crops was conducted before gathering the photos, and the following diseases were chosen for closer inspection.

Alternation:

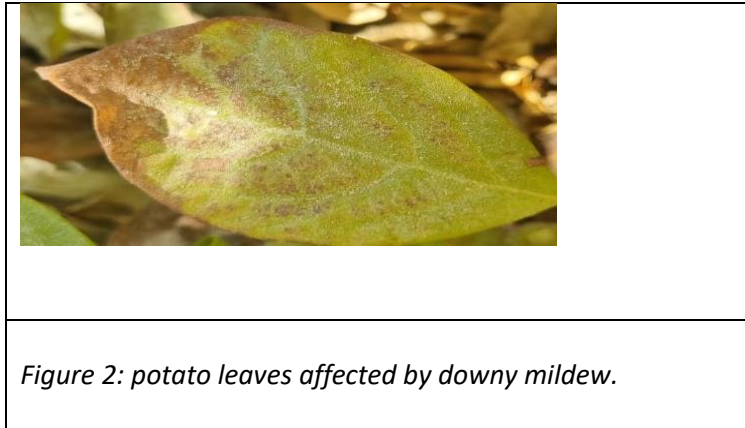
Early Blight mushrooms, also known as Alternation, have dark brown concentric rings in the shape of a circle. Older leaves are typically the first to become infected, although the disease can spread to the whole plant's foliage and result in complete defoliation.



Figure 1: Alternation on a Potato Leaf

The development of downy mildew is facilitated by high humidity, and the life cycle of this fungus is highly complex, involving the synthesis of several types of spores. The most harmful and destructive pest, it can cause the

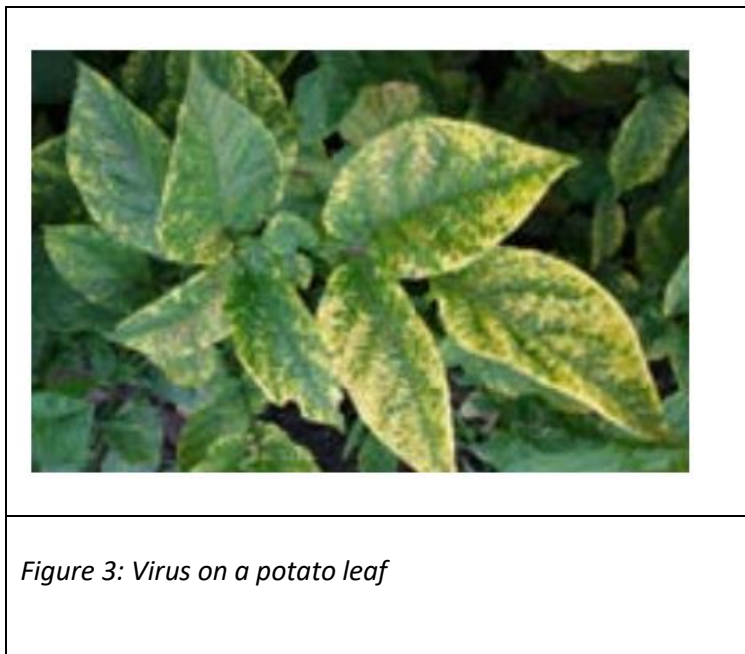
defoliation and death of plants in a matter of hours under ideal conditions (Pazmiño Guevara, 2021).



Dwarfism, leaf yellowing, leaf distortion, and leaf and tuber necrosis are all symptoms of the viral disease known as vironosis. Note also that "its importance rests in the fact that it creates considerable losses

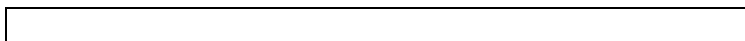
in crop production and quality, and an increase in the refusal of seedbeds for certification," highlighting its negative impact on agricultural productivity(Nascimento, 2021).

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Ahead-of-time manipulation of images

It can be seen in Figure 4 how the image contrast is enhanced by the various methods utilized in the acquisition process.



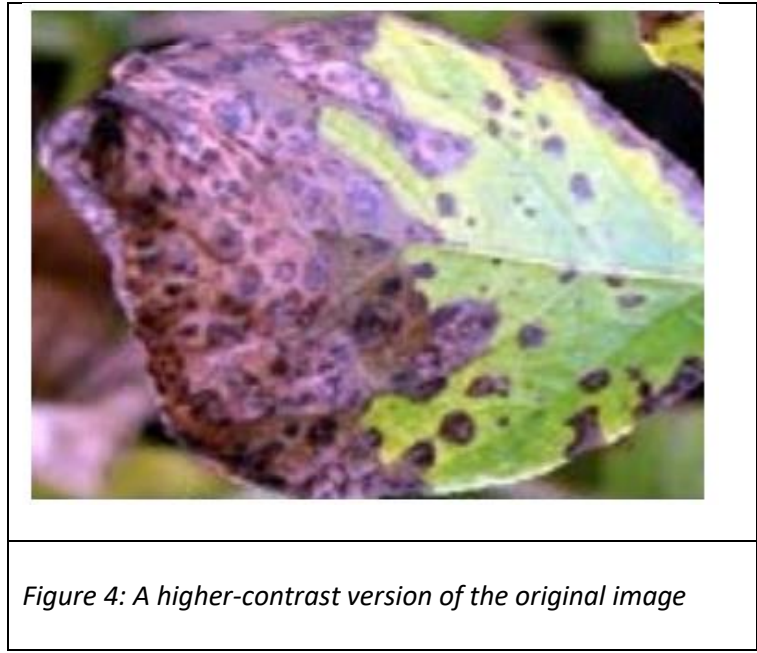
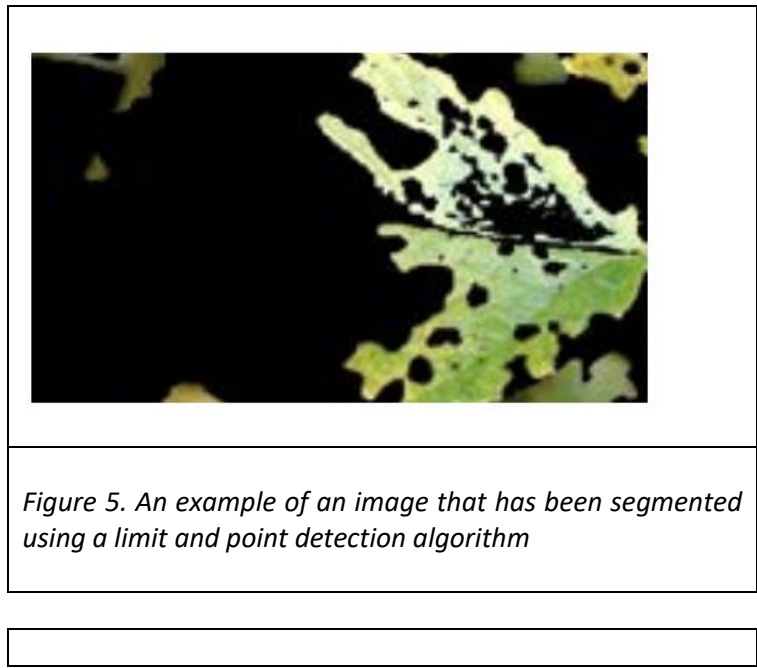


Image segmentation

The following results from the picture segmentation demonstrate how different segmentation types lend distinctive

characteristics to the image, highlighting the disease differently. Limit and point detection technique for segmentation (Montecchia et al., 2021).

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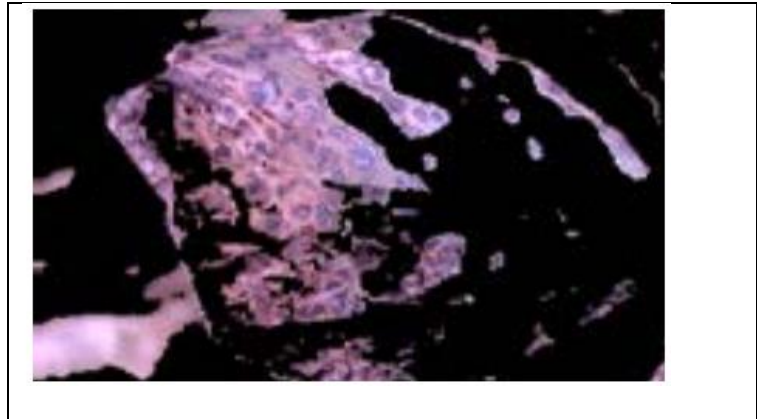


Figure 6. K-means clustering applied on a segmented image

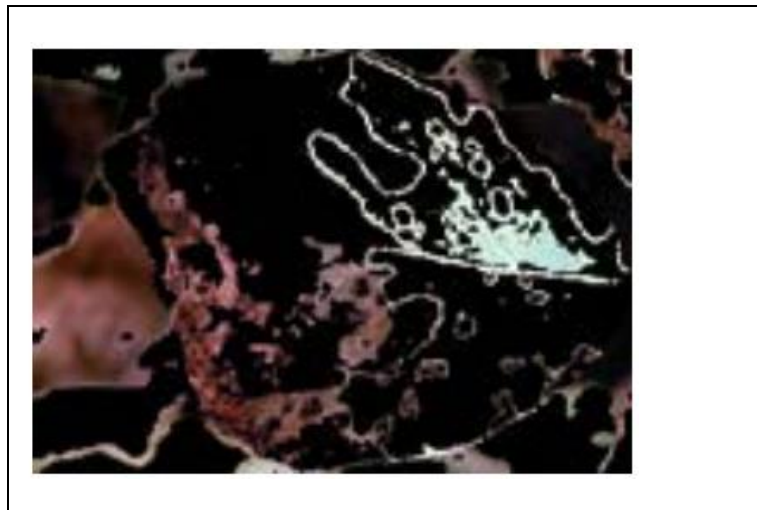


Figure 7: Otsu threshold algorithm-based image segmentation.

Determining Important Characteristics

Fourteen data were generated from the characteristic extraction process, and these data closely match the image captured for illness diagnosis.

Using a neural network for classification in an ANN (Artificial Neural Networks) system

The examined leaf's disease is determined by comparing the retrieved data with a database of the three selected infections.



Figure 8: The outcome of comparing the included image to the norm

CONCLUSIONS:

Early detection of a pest at an early stage saves time and costs in applying the necessary treatment, producing healthy products for consumption, and reducing contamination due to the excessive use of fungicides; thus, early detection of diseases that occur in potato crops during the development processes is of great importance. Additionally, various techniques exist for segmenting the part of the plant disease, extracting and classifying characteristics to identify the primary traits of the infected leaves, and organizing the plant diseases; when combined with image processing, these methods allow for the accurate detection of several plant diseases that exist (Carter et al., 2020).

Additionally, ANN learning neural networks, such as self-organizing feature maps, back propagation algorithms, SVM, etc., can be employed effectively for plant disease classification. Using these strategies, we may accurately use image processing tools to identify and categorize various plant illnesses (Shen et al., 2020).

Finally, it is possible to guarantee that technological equipment is a driving force in the evolution of work and, hence, ideal outcomes for the sector concerning the sowing and harvesting of potato crops in the agricultural industry.

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