Detection of Disease in Grape and Pomegranate Plants using Content Base Image Retrieval technique

***[1,2]Bhagawan N. Kadlag, [1]Dhanjay N. Kadlag, [3]Chandrakant G. Dighavkar, [4]Arun V. Patil**

*[1]Assistant Professor, Dept. of Electronic Sci., K. K. W. College, Pimpalgaon (B.), Nasik (M.S.) 422209, Maharashtra, India.
[2]Research Scholar, Department of Electronic Science and Research Centre, MGV's L. V. H College, Panchavati, Dist. Nashik, 422003, Maharashtra, India.
[3]Department of Physics, MGV's Maharaja Sayajirao Gaikwad Arts, Science and Commerce College, Malegaon Camp, Malegaon, Dist. Nashik, 423105, Maharashtra, India.
[4]Department of Physics, MGV's, Arts, Science and Commerce College, Surgana, Dist. Nashik, 422211, Maharashtra, India.
Corresponding author: kadlag1985@gmail.com

Abstract:
This research paper presents a novel approach for the early detection of diseases in grape and pomegranate plants using a content-based image retrieval (CBIR) technique. The agricultural industry faces significant challenges in monitoring and diagnosing plant diseases, which can have adverse effects on crop yield and quality. Traditional disease identification methods often rely on visual inspection by experts, which can be time-consuming and prone to human error. In this study, we propose an automated system that leverages the power of computer vision and MATLAB to assist in the rapid identification of diseases in grape and pomegranate plants. Obtained results demonstrate the efficacy of the proposed CBIR-based system in accurately identifying diseases in grape and pomegranate plants. By automating disease detection and reducing the dependency on manual inspection, this research contributes to the advancement of precision agriculture and the early management of plant diseases, ultimately improving crop yield and sustainability.

Keywords: Crop yield, precision agriculture, plant diseases, monitoring, sustainability, MATLAB.

I. Introduction:

Content-based image retrieval (CBIR) is a technique used in computer vision and information retrieval to search and retrieve images from a database based on their visual content rather than relying on textual descriptions or tags [1]. CBIR systems analyze the visual features of images, such as color, texture, shape, and spatial arrangement, to compare and match them to user-provided queries or sample images [2, 3]. The basic idea behind CBIR is to search for images that are similar to a query image based on their content, such as color, texture, and shape. In the context of plant disease identification, CBIR can be used to match a query image of a diseased plant with a database of images of known plant diseases [3, 4].

Image processing is currently extensively utilized in fields including engineering, navigation, medicine, geography, weather forecasting, and the agricultural sector, among many others. A very practical and effective tool for this kind of application is MATLAB. Numerous systems have been produced with MATLAB throughout the years at an international level, and a great deal of research has been conducted using MATLAB [5, 6]. MATLAB is particularly beneficial in the domains of science, technology, electronics, and many others because of its simplicity, strong GUI, and sophisticated graphics [5-8].

The traditional method for identifying and diagnosing fruit illnesses relies solely on skilled observation with the naked eye. Due to their remote locations, consulting specialists can be expensive as well as time-consuming in some underdeveloped nations. To automatically identify disease symptoms as soon as they emerge in developing fruits, automatic fruit disease detection is crucial. This technique makes it simple to identify fruit illnesses. Using this technique will help us prevent farmers from losing money. The proposed system in this research paper is definitely useful for farmers for indicating early detection of fruit or plant diseases [9, 10].

II. Steps of Detecting diseases in grape and pomegranate plants using CBIR:

Detecting diseases in grape and pomegranate plants using a content-based image retrieval (CBIR) technique in MATLAB involves several steps. CBIR can help identify plant diseases by comparing images of healthy and infected plants based on their visual content. Some steps are involved for detecting diseases in grape and pomegranate plants using CBIR as follow [11-14].

Step 1: Image Acquisition

Collect a dataset of images of grape and pomegranate plants, including both healthy and diseased samples. Required a sufficient number of images for each class (healthy and diseased) to train and test system effectively.

Step 2: Image Preprocessing

Preprocess the acquired images to enhance their quality and standardize them for analysis. Common preprocessing steps include resizing, noise reduction, and color correction.

Step 3: Feature Extraction

Extract relevant features from the images. In CBIR for plant disease detection, we can use various visual features, such as color histograms, texture descriptors, and shape features. These features should capture the unique characteristics of healthy and diseased plants.

Step 4: Feature Database Creation

Create a database of extracted features for all the images in dataset. Each image should be associated with its feature vector, and you will use this database for querying.

Step 5: Query Image Selection

Choose a query image of a grape or pomegranate plant with an unknown disease for which we want to identify the disease. This query image will serve as input to the CBIR system.

Step 6: Feature Extraction for Query Image

Extract features from the query image using the same methods and feature extraction techniques applied to the training dataset.

Step 7: Similarity Measure

Calculate the similarity between the feature vector of the query image and the feature vectors of images in your database. Common similarity measures include Euclidean distance, cosine similarity, or other appropriate distance metrics based on the features used.

Step 8: Ranking and Retrieval

Rank the images in the database based on their similarity to the query image. The images with the highest similarity scores should be retrieved and considered as potential matches.

Step 9: Disease Identification

Based on the retrieved images, you can identify the disease in the query image by examining the corresponding labels or metadata associated with the retrieved images. These labels should indicate whether the plants in the retrieved images are healthy or diseased.

Step 10: Post-processing and Visualization

A visualize the retrieved images and their corresponding disease labels in MATLAB to assist in disease identification

Step 11: Evaluation

Required ground truth data (known disease labels) for dataset, we can evaluate the performance of your CBIR system using metrics like precision, recall, and F1-score.

Step 12: Refinement and Optimization

We can refine and optimize your CBIR system by experimenting with different feature extraction methods, similarity measures, and image preprocessing techniques to improve its disease detection accuracy.

By following these steps and using MATLAB's image processing and feature extraction functions, for develop a content-based image retrieval system for disease detection in grapes and pomegranate plants. Figure 1 reveals the framework of proposed system.

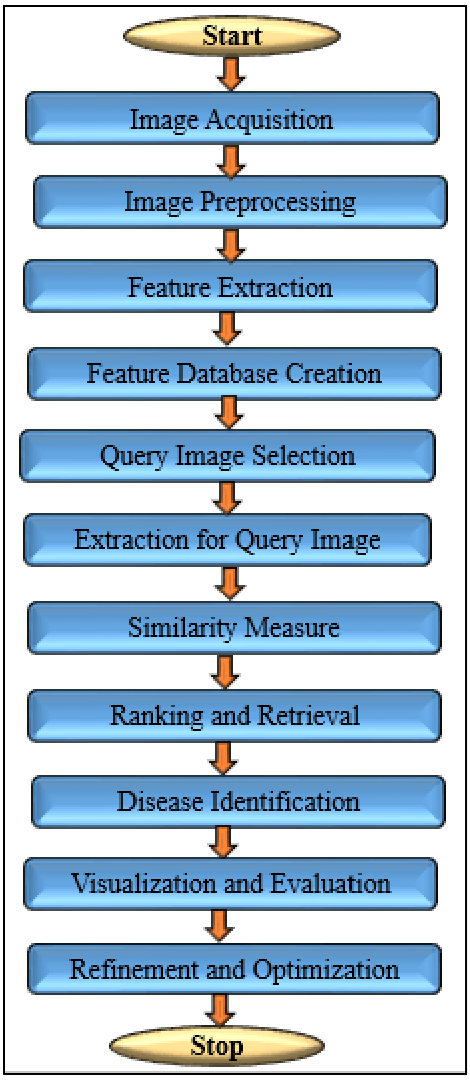

Figure 1: Framework of proposed system

III. Literature survey

Tejas Deshpande et al (2014) suggested grading illness automatically on pomegranate plant leaves. The investigation is focused on the bacterial blight illness. Because manual grading takes time, automatic grading systems are useful. For performing image segmentation and disease detection, K-means clustering is used. Calculations are made for total leaf area and total disease area. Disease grading has been completed after calculating leaf area and total disease area. Plant pathologists can benefit from this approach, not actual farmers [15].

Jhuria, et al (2013) method for identifying and detecting fruit disease based on image processing was proposed. For the trials, apples were chosen as the fruit, and the illnesses taken into consideration were apple rot and apple blotch. K-means clustering is utilized in the segmentation of images. To extract the features, the following methods are used: color coherence vector, histogram, full local binary patterns, and local binary patterns. Multiclass support vector machine is employed in the diagnosis of fruit diseases [16].

Dubey, S.R. et al (2012) presented a method based on image processing for fruit disease identification. Fruit disease detection is the aim of research work. Mangoes, apples, and grapes have been chosen as the experimental subjects. The feature extraction process uses feature vectors for morphology, color, and texture. Compared to other feature vectors, the morphology feature provides 90% reliable results. Image processing methods are employed for fruit weight calculation and illness diagnosis. For weight adjustments on images kept in learning databases, back propagation is used. The categorization of fruit has been determined based on the spread of disease (17).

Iqbal, Z. et al (2018) carried out review on an automated detection and classification of citrus plant diseases using image processing techniques. This article provides a survey of the many approaches for identifying and categorizing citrus plant leaf diseases. The page provides a comprehensive taxonomy of citrus leaf ailments. The difficulties of each stage are first explored in detail, which has an impact on detection and classification accuracy. Additionally, a complete analysis of the literature on automated disease detection and categorization techniques is provided. Researchers examine several techniques for image preprocessing, segmentation, feature extraction, feature selection, and classification. Additionally, touch on the significance of feature extraction and deep learning techniques. A detailed discussion of the studies was also offered, including their advantages and disadvantages as well as revealing other research problems. According to the study results, automated technologies for disease detection and categorization in citrus plants are currently being developed (18).

Kaur, S et al (2019) reported and carried out literature survey on plants disease identification and classification through leaf images. In order to shed light on many significant study issues, authors summarize the benefits and drawbacks of all such investigations. The presentation includes a discussion of often studied infections and a research scenario for the various stages of a disease detection system. The effectiveness of cutting-edge methods is evaluated in order to pinpoint those that appear to be effective across a variety of crops or crop classifications. The article highlights numerous aspects of consideration along with the future research directions after identifying a group of approved methodologies. Researchers could better grasp plant disease detection uses for computer vision with the aid of the survey (19).

Prasad, S. et al (2016) proposed system for plant leaf disease diagnosis which is based on multi-resolution mobile vision. In this work, a novel combination of the Gabor wavelet transform (GWT) and gray level co-occurrence matrix (GLCM) is offered, opening up a new dimension in pattern recognition, for the detection and diagnosis of leaf illness. A sick patch is represented as a multi-resolution, multi-direction feature vector in a mobile disease diagnosis system. Reduced transmission costs are achieved via the mobile client's pre-processing, segmentation, and transfer of the leaf picture to the pathology server. The computational operations of GWT-GLCM feature extraction and k-Nearest Neighbor classification are carried out by the server. An accurate 93% of the time, the result is returned to the user's screen via an SMS (short messaging service). The other portion of the study focuses on the creation of a human-mobile interface (HMI), which allows even illiterate farmers to automatically monitor their fields at any stage with a single cellphone click (20).

Barbedo, J. et al (2014) employing standard color digital photos, a method is described to identify and measure leaf diseases. The system was developed to be fully automatic, eliminating any chance of human error and cutting down on the amount of time needed to assess disease severity. The application can handle photos with many leaves, which further cuts down on processing time. When the symptoms and leaf veins exhibit similar color and shade characteristics, accurate findings may be obtained. One restriction on the algorithm is that the background must be as near to white or black as possible. Tests revealed that the method produced accurate estimates under a wide range of circumstances and was resistant to variations in the size, shape, and color of the leaves as well as in the symptoms and veins of the leaves (21).

Iniyan, S. et al (2020) suggested plant disease identification and detection using support vector machines and artificial neural networks. Authors discussed about the use of artificial neural networks (ANN) and support vector machines (SVM) for the identification of agricultural diseases. The survey's findings include the advantages and disadvantages of each approach in relation to the input variables (22).

Kebapci, H. et al (2011) proposed a content-based image retrieval system for plants, specifically for the identification of home plants. The problem is difficult since a plant image consists of a collection of overlapping leaves and potentially flowers. In addition to presenting some fresh texture matching strategies and form characteristics, authors investigated the applicability of numerous well-known color, shape, and texture features for this issue. After utilizing the max-flow min-cut technique to separate the plant region from the backdrop, feature extraction is used. Outcomes on a database of 380 plant photographs from 78 distinct plant kinds demonstrate the potential of the new methodologies that have been proposed, as well as the system as a whole: in 55% of queries, the correct plant image is returned among the first 15 results. Furthermore, the accuracy increases to 73% when 132 well-segmented plant picture subsets are taken into account (23).

Kavitha, P. (2021) suggested fuzzy multi-characteristic clustering method, based on fuzzy clustering and logic, to achieve this goal. In user query, similarity measure, and image substance, fuzzy sets are utilized to express the fuzziness. Clustering is a classification technique that is unsupervised, offers just a little control, and significantly boosts clustering performance. Proposed method can reach notable precision and recall rates with greater computational efficiency, according to the first results (24).

IV. Proposed Framework

Figure 2 represents the framework of proposed system and explain the working of developed system as below steps.

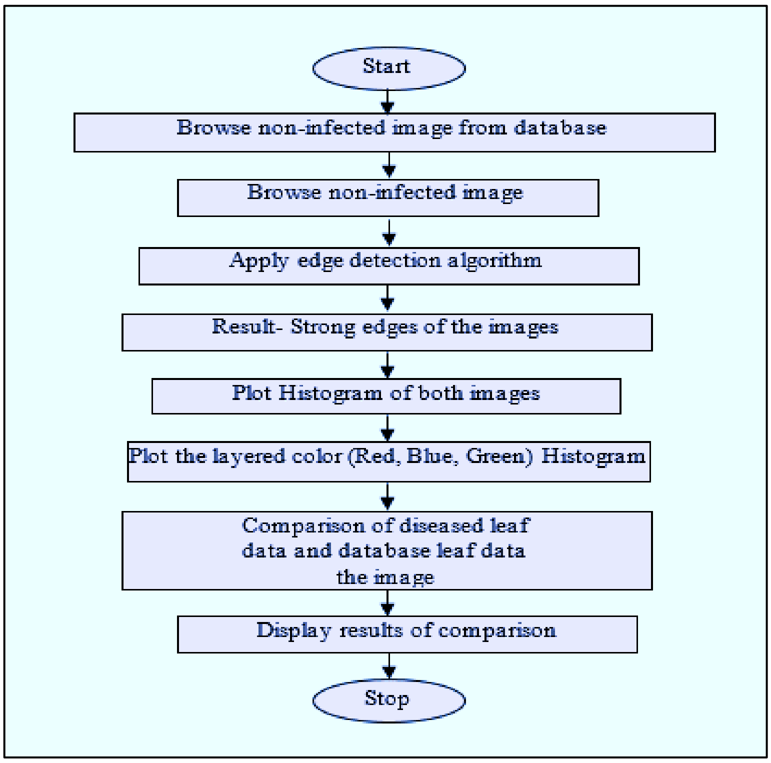

Figure 2: framework of proposed system

1. We have used the MATLAB software tool in the current improvements in light of these advanced characteristics. The tool's design and advancements are as follows:
2. Under the direction of the specialists, samples of both healthy and diseased leaves were taken from the botanical garden. The samples that were taken were from various crops with both healthy and diseased leaves. Every leaf must test the designed tool. The same plant's leaves come in both diseased and disease-free samples.
3. The GUI shows on the user screen after the CBIR diagnostic tool has been launched. The user then selects a non-infected image from their memory that corresponds to the image of the diseased leaf that has to be diagnosed by clicking the 'Enter original image' button.
4. As the next diagnostic step, a user has to provide the image of the infected leaf under diagnosis for comparison. For this, the user clicks on the '**Enter diseased image'** button and selects appropriate leaf image from the drive.
5. Further clicking on '**push button 1'** enables the program to scan the non-infected leaf image and generates its RGB histogram.
6. The Same procedure given in step 3 above is repeated for infected leaf image using '**push button 2'** to generate its RGB histogram.
7. Further by clicking onto the '**push button 3'** results in generating edge detected images of the infected and non-infected leaf images respectively.
   Figure 3 shows the output of developed system.

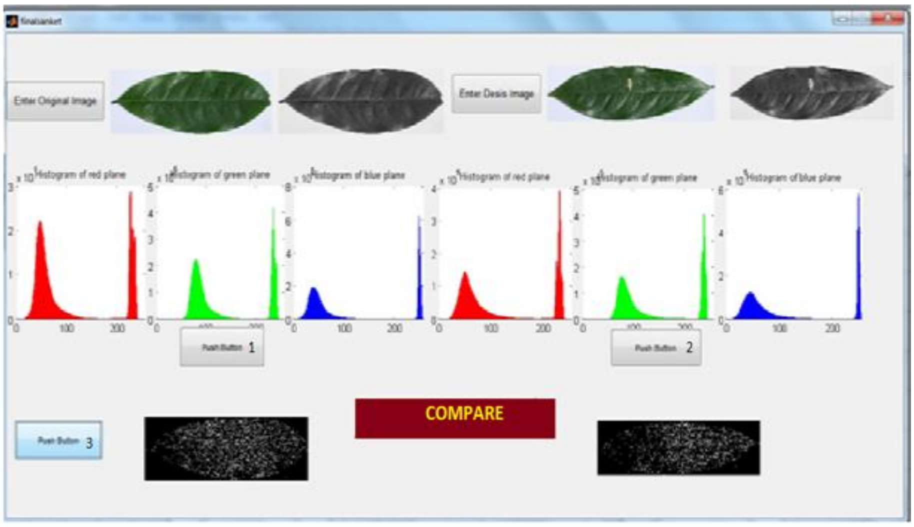

Figure 3: output of developed system

Conclusion:

This research offers a promising solution for real-world applications in agriculture and provides a foundation for future developments in the field of automated plant disease diagnosis. For an effective CBIR tool for plant disease identification requires careful consideration of the dataset, feature selection, similarity measurement, and user interface design. Additionally, regular updates and improvements are essential to ensure the system remains accurate and useful to its intended users.

Acknowledgement

Authors very much thankful to Department of Electronic science and research centre MGV's L. V. H College, Panchavati, Dist. Nashik, 422003, Maharashtra, India for providing lab facility and support for current research work.

Funding Source

This research received no specific grant from any funding agency.

Conflict of Interest

The authors have no conflicts of interest to disclose.

References

1. Li, X., Yang, J. and Ma, J., 2021. Recent developments of content-based image retrieval (CBIR). Neurocomputing, 452, pp.675-689.
2. Müller, H., Müller, W., Squire, D.M., Marchand-Maillet, S. and Pun, T., 2001. Performance evaluation in content-based image retrieval: overview and proposals. Pattern recognition letters, 22(5), pp.593-601.
3. Pawara, S., Nawale, D., Patil, K. and Mahajan, R., 2018, April. Early detection of pomegranate disease using machine learning and internet of things. In 2018 3rd International Conference for Convergence in Technology (I2CT) (pp. 1-4). IEEE.
4. Barhate, Priyanka Vijay, and Bhojraj Hanumant Barhate. "Review of Detection of Fruit Diseases Using Image Processing and Machine Learning Techniques." In Special Issue on 7th National Conference on "Emerging Trends in Computer and Information Technology", p. 10.
5. Rao, C.S. and Kumar, S.S., 2008, February. Content based image retrieval using contourlet sub-band decomposition. In Proceedings of SPIT-IEEE Colloquium and International Conference (Vol. 1, No. 140).
6. Majumdar, D., Kumar, D., Chakraborty, A. and Dutta, D., 2014. Detection & diagnosis of plant leaf disease using integrated image processing approach. International Journal of Computer Engineering and Applications, VI–III.

7. Chatterjee, S., Dasgupta, S. and Bhattacharya, I., 2022, December. Leaf-Based Plant Disease Detection Using Intelligent Techniques—A Comprehensive Survey. In International Conference on Frontiers in Computing and Systems (pp. 81-90). Singapore: Springer Nature Singapore.
8. Sharath Kumar, Y.H. and Suhas, G., 2017. Identification and classification of fruit diseases. In Recent Trends in Image Processing and Pattern Recognition: First International Conference, RTIP2R 2016, Bidar, India, December 16–17, 2016, Revised Selected Papers 1 (pp. 382-390). Springer Singapore.
9. Bhange, M.A. and Hingoliwala, H.A., 2015. A review of image processing for pomegranate disease detection. International Journal of Computer Science and Information Technologies, 6(1), pp.92-94.
10. Noola, D., 2018. Disease Identification of Pomegranate Fruit using Image Processing. Asian Journal For Convergence In Technology (AJCT) ISSN-2350-1146, 4(3).
11. Vishnoi, V.K., Kumar, K. and Kumar, B., 2021. Plant disease detection using computational intelligence and image processing. Journal of Plant Diseases and Protection, 128, pp.19-53.
12. Sinha, A. and Shekhawat, R.S., 2020. Review of image processing approaches for detecting plant diseases. IET Image Processing, 14(8), pp.1427-1439.
13. Chakali, R., 2020. Effective pomegranate plant leaf disease detection using deep learning. International Journal of Circuit, Computing and Networking, 1(2), pp.08-10.
14. Rajpal, N., Yadav, J. and Mondal, K.K., 2022. Multi-resolution analysis and deep neural network architecture based hybrid feature extraction technique for plant disease identification and severity estimation. Evolutionary Intelligence, pp.1-21.
15. Deshpande, T., Sengupta, S. and Raghuvanshi, K.S., 2014. Grading & identification of disease in pomegranate leaf and fruit. International Journal of Computer Science and Information Technologies, 5(3), pp.4638-4645.
16. Jhuria, M., Kumar, A. and Borse, R., 2013, December. Image processing for smart farming: Detection of disease and fruit grading. In 2013 IEEE second international conference on image information processing (ICIIP-2013) (pp. 521-526). IEEE.
17. Dubey, S.R. and Jalal, A.S., 2012, November. Detection and classification of apple fruit diseases using complete local binary patterns. In 2012 Third International Conference on Computer and Communication Technology (pp. 346-351). IEEE.
18. Iqbal, Z., Khan, M.A., Sharif, M., Shah, J.H., ur Rehman, M.H. and Javed, K., 2018. An automated detection and classification of citrus plant diseases using image processing techniques: A review. Computers and electronics in agriculture, 153, pp.12-32.
19. Kaur, S., Pandey, S. and Goel, S., 2019. Plants disease identification and classification through leaf images: A survey. Archives of Computational Methods in Engineering, 26, pp.507-530.
20. Prasad, S., Peddoju, S.K. and Ghosh, D., 2016. Multi-resolution mobile vision system for plant leaf disease diagnosis. Signal, image and video processing, 10(2), pp.379-388.
21. Barbedo, J.G.A., 2014. An automatic method to detect and measure leaf disease symptoms using digital image processing. Plant Disease, 98(12), pp.1709-1716.
22. Iniyan, S., Jebakumar, R., Mangalraj, P., Mohit, M. and Nanda, A., 2020. Plant disease identification and detection using support vector machines and artificial neural networks. In Artificial intelligence and evolutionary computations in engineering systems (pp. 15-27). Singapore: Springer Singapore.
23. Kebapci, H., Yanikoglu, B. and Unal, G., 2011. Plant image retrieval using color, shape and texture features. The Computer Journal, 54(9), pp.1475-1490.
24. Kavitha, P.K. and Vidhya Saraswathi, P., 2021. Content based satellite image retrieval system using fuzzy clustering. Journal of Ambient Intelligence and Humanized Computing, 12, pp.5541-5552.