JSRT JOURNAL
PAGES: 68-78
8/28/24
JOURNAL OF SCIENTIFIC RESEARCH AND TECHNOLOGY VOLUME-2 ISSUE-8 AUGUST

Vegetable Leaf Identification System Using Image Processing

Channamma Chinamalli[1], Dr. Megha Rani Raigonda[2]

[1]*Student, Department of Computer Science, Visvesvaraya Technological University, Kalaburagi, India. channammac153@gmail.com*
[2]*Assitant Professor, Department of Computer Science, Visvesvaraya Technological University, Kalaburagi, India. megharaigond@gmail.com*

ABSTRACT

Identification of vegetables Leaf is essential to various agricultural and food-related applications Manual plant recognition by human experts is achievable, but the method could be more efficient and efficient. This study presents a robotic leaf recognition technique for vegetables using MATLAB, a powerful platform for software, a popular way for processing images and pattern recognition. The proposed system employs a multi-stage approach to accurately identify and classify vegetable leaves. Initially, picture of a leaf preprocessed to enhance their quality the contrast enhancement removes any noise or unwanted artifacts. and are applied to improve efficiency of future analysis. Next, extraction of features is performed on the preprocessed images to convert them into meaningful representations. A group of relevant and discriminative features, such as shape, texture, and color, are removed utilizing methods such as grey level co-occurrence (GLCM), In the classification stage, a algorithm for machine learning is on a dataset of labeled vegetable leaves to learn the mapping between the classes that match to the retrieved features. SVMs, or vector support machines, are classifiers, k-Nearest Neighbors (k-NN), After training, the classifier can forecast the class labels of unseen vegetable leaves since extracted features. The proposed MATLAB-based system is evaluated using a diverse dataset of vegetable leaf images, encompassing various species and leaf types, the proposed system attends improved accuracy compare to traditional human being The proposed system SVM algorithm can give reliable outcome using the percentage of 96.77%.

Keywords: Image Processing, Matlab, SVM Algorithm, Leaf Recognition system

1. INTRODUCTION

India is a cultivated country and about 70% of the population depends on agriculture. Farmers can choose from an extensive range of suitable crops and choose the best insecticides for plants. Plant leaves are categorized according to their shape and texture—a practical classification framework this investigation was conducted to categorise dataset of 18 species of leaves. First, a categorization based on system leaf morphology is explained since distance and angle of the contour the points from centre of the Leaf, two contour signatures are computed. Every Leaf in the dataset undergoes this procedure, and the Jeffrey distance utilized to determine how unlike the graphs are from one another. The contour signature approach, used for this categorization, The findings indicate that 10 out of 18 species have been correctly categorised, with a classification rate greater than 85% in 10 cases, and more than 75% in 4 other cases. Overall, 81.1% of cases were classified correctly [4]. leaf identification of medicinal plant utilizing textural traits, this study analyses the identification of herbal plants using leaf texture signals. A comparison study that is depending on three common textural features This study has a 99% accuracy rate and employs an SVM (Support Vector Machine) with several classes classifier to compare three typical texture features: the Gradients in an Oriented Histogram (HOG), Binary Pattern Locally (LBP), and Robust features that work quickly (SURF) [6]. Species identification of plants by leaf morphology. This work presented and used an automated recognition approach for plant photos based on digital morphological features. It is evident that when compared to the 1- NN and k-NN classifiers [9]. Identifying plant species from images of their leaves may be done automatically using the Gabor Filter. Three different plant species' leaves are assessed by adjusting the filter's settings. The genuine and fictitious components of the signal are separated after leaf images are combined using Gabor filters. The absolute difference between the real and imaginary signals is utilized to create scalar feature value for discrimination. Modifications are made to associated variables such filter size, standard deviation, phase shift, and orientation to find which configuration delivers the maximum identification accuracy. To achieve classification, average of the exercise set is deducted in the test samples' mean. 120 images divided into 3 groups make up the data set utilised in this research [10].

1.1.1 Problem statement

Specifically for biologists, agricultural scientists, and environmentalists, the recognition of a plant crucial issue. Although manual plant recognition may be done by professionals by hand, it is a difficult and inefficient operation. For fields working with plants, An essential first step is the automation of plant recognition. The study presents a method for identifying plants using photographs of their leaves. This study the developers within the system allows users to determine the type of vegetables photographing the leaves obtained on a high resolution camera were displayed.

1.1.2 Objective of the study

- Downloading the dataset and applying preprocessing methods collect a huge number of high-quality photographs of vegetable leaves that represent a variety of species, development phases, and environmental factors.
- Applying segmentation methods, It involves dividing a vegetable leaf picture into useful segments or parts.
- To apply Feature Extraction techniques, Develop efficient methods to extract relevant attributes of the leaf images, such as shape descriptors, texture patterns, and color histograms.
- Model Machine Learning Selection and Training Select the proper machine learning using techniques such as SVM or Convolutional Neural Networks (CNNs).
- To use Matlab to make an Automated Vegetable Leaf Recognition system.

1.1.3 Methodology

Different classification methods, including KNN, Decision Trees, Analyse Discrimination, SVM and for this study's the identification of various varieties of vegetables.

- **SVM algorithm**
- **KNN algorithm**
- **Decision tree**
- **Discriminant analysis**

2. LITERATURE SURVEY

Chaki J. & Parekh R [1] Creating an automated method for recognising plant leaves. The study proposes an automated a system used for identifying plant species photographs of their leaves. Modeling three different shapes strategies, the first two are based on the Centroid- Radii (C-R) and Moments-Invariant (M-I) models, respectively. model, he third based on a specified methodology, as well. binary superposition (B-S), are employed in analyze plant leaf photos representing three different plant species. for the M-I, A model's first four central normalised moments were considered consideration. In relation to the C-R model, the form vector was constructed using 36 radii spaced ten degrees intervals, and the border shaped like a leaf was identified using an edge detector. The suggested strategy compares binary copies that leaf pictures by superimposing them, and the resultant's total of the non-zero values for pixels is used serves as the characteristic vector 180 images, split between training and Forms, make up the experiment data set. The accuracy attained with the suggested method is seen as being better than the M-I and C-R based methods, with a maximum performance of 92% accuracy.

Backes, A.R., Bruno, O.M [2] Plant leaf identification using multi-scale fractal dimension. Journal International Conference on Image Analysis and Processing. The study of the complexity of a leaf's color and texture pattern served as the foundation for classifying leaves. We highlight that because there is considerable similarity across classes and limited similarity within classes, identifying leaf textures is a particularly challenging assignment. The Bouligand-Minkowski technique and the Multi-scale Fractal Dimension were used to conduct the complexity study. The investigation of the organization of the texture's pixels and also variations in its structural complexity throughout the scale are made possible by the approaches' high sensitivity to changes in texture behavior. In a study the developed classifiers by means of linear discriminant analysis to categorize a collection of previously chosen leaf textures. The suggested system uses a leaf database created using 10 leaf species from Brazilian flora. A comparison with conventional color texture analysis methods was also conducted, and the findings demonstrate the significant potential of the suggested approach for natural texture analysis applications. Three samples of each type of leaf species were hand gathered for this investigation with a 96.00% accuracy rate.

Cope.James S, Remagnino.Paolo, Barman.Sarah, and Wilkin.Paul [3] Classification of plant textures using Gabor co-occurrences. Comparative plant biology is the research on the Leaf is a crucial source of information. Considering the comparison classification of and plants using leaf texture, this study proposes a methodology. Calculations are made for the joint distributions of the Gabor filter responses at various scales. The Jeffrey divergence measure of related distributions used to determine the difference between leaf textures. To emphasize this method's more common use, In addition used in the Brodatz texture database, both the outcomes when compared to results from techniques for analysing texture more widely used. The method also produced excellent classification rates on the Brodatz texture database, doing just marginally worse on the complete 111 classes than on a 40 class subset in this study. accuracy rate 95.50%.

T. Beghin, J. S. Cope, P. Remagnino, & Barman.S [4] Plant leaf categorization is based on shape and texture. In this study, a framework for effective categorization of a dataset of 18 species of leaves was provided. The categorization system based on leaf form is discussed first. Based on the separation and inclination of the contour points from the Leaf's center, two contour signatures are computed. Every Leaf in the dataset undergoes this procedure, and the differences between the graphs are determined using the Jeffrey distance. The contour signature approach of categorization yields surprisingly good outcomes. The selection of the signature's inflection points allows for further enhancement by separating the lobes from the unlobed leaves. Secondly, To identify the differences in the leaves' macro-texture, a classification utilizing the Sobel operator is performed. The direction and size of the edge gradients utilised to create a histogram. Then, but not least a technique is constructed that combines the lobe differentiation, the shaped-based, and the texture-based methods using probability density functions. The goal of the incremental method is to maximize the possibility of each distinct technique. The findings indicate that 10 out of 18 species have been correctly categorized, with a classification rate of more than 85% in 10 cases, and more than 75% in 4 other instances overall, 81.1% of cases were classified correctly.

Arivazhagan, S., L. Ganesan, and S. Priyal [5]Texture categorization using rotation- invariant features based on Gabor wavelets.Identifying a class for a moderately big (111 classes) texture database, a rotation-invariant texture classification system based on two group characteristics (global feature vector and local feature matrix) is created. By using the the median and range of the filtered Gabor picture, two group features, the global feature vector and local feature matrix, may be created. To ensure that all pictures have the same dominant direction, the global feature vector is rotation invariant, and the local feature matrix may be made to be the same by performing a circular shift operation. One may find a discriminant to categorize rotated photos using both groups characteristics. The main studies have demonstrated The efficiency of the suggested method for classifying rotation-invariant textures. There are several uses, including as auto automatic inspection, managing big picture data bases, remote sensing, and medical image processing. Its resilience to picture noise and scale invariant texture classification in this study's accuracy rate should both be investigated further. 93%

2.1 Hardware Requirements

Table 1: Hardware Requirements

Processor	Intel Core I3 and above
Processor Speed	1.0 GHZ or above
RAM	4 GB RAM or above
Hard Disk	256 GB SSD or 500 GB HDD

2.2 Software Requirements

Table 2: Software Requirements

Operating system	Windows 10 or above
Programming Language	Python
Web Framework	Flask

3. SYSTEM DESIGN

3.1 System Perspective

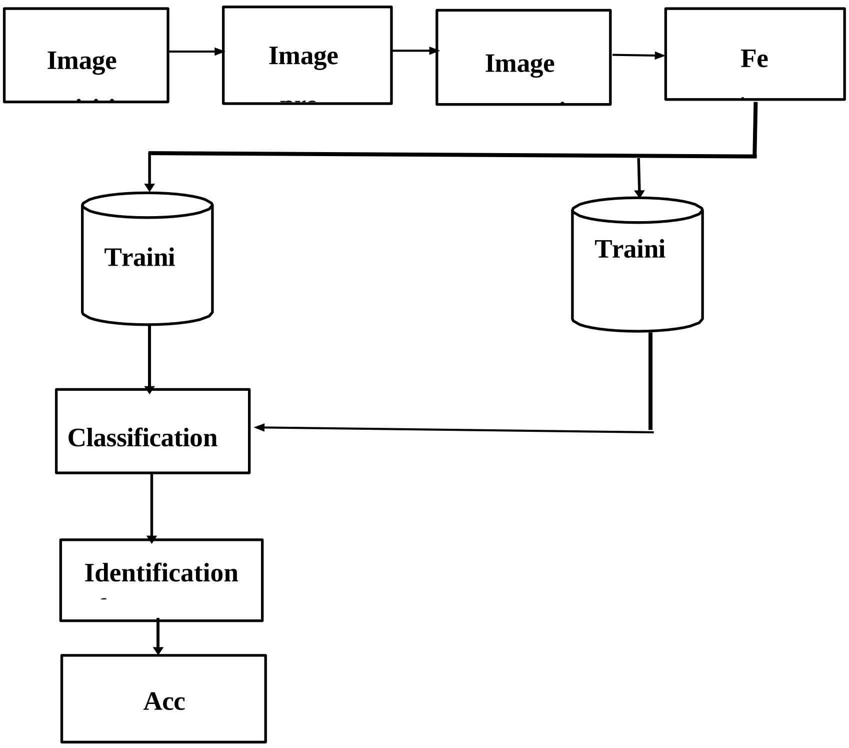

Figure 1: Block diagram of leaf recognition of vegetable

4. IMPLIMENTATION

- Dataset Preparation : Collect a variety of vegetable leaf images, noting the various shapes, colours, textures, and sizes. Multiple samples of each vegetable type should be a component of dataset to ensure proper representation.

- Preprocessing : To enhance the leaf photographs' quality, use preprocessing techniques such image scaling, normalisation, and noise reduction. This action enhances the recognition system's resilience and accuracy.

- Feature Extraction : To extract distinguishing characteristics from the preprocessed leaf pictures, using feature extraction approaches such as Scale-Invariant Feature Transform (SIFT), Speeded-Up Robust characteristics (SURF), or Local Binary Patterns (LBP). These traits ought to convey the distinctive qualities of each vegetable leaf.

- Classification Model : CNN, Support vector machines (SVM), The best way to train a classification model, one can employ,, and other using machine learning. Train the model to recognise vegetable leaves accurately utilizing the retrieved features and matching class labels.

- Testing and Evaluation : Apply a different testing dataset to the trained model's evaluation. Look at performance metrics like precision and accuracy, recall, and F1 score to gauge effectiveness of the leaf identification system. Change the model's parameters as necessary to improve performance.

4.1 Screen shots

Figure 4.1 : Main page of Leaf Recognition of Vegetables

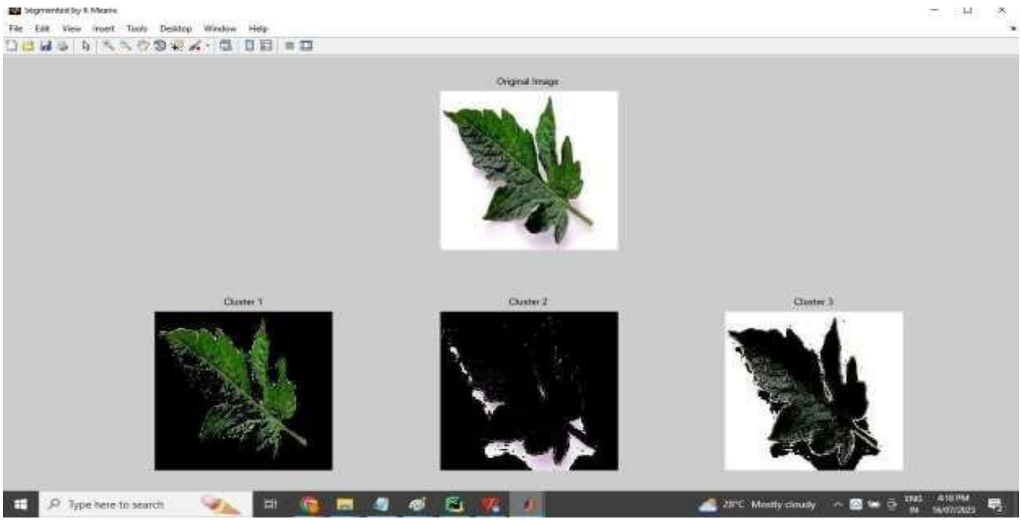

Figure 4.2 : Vegetable Leaf Segmentation

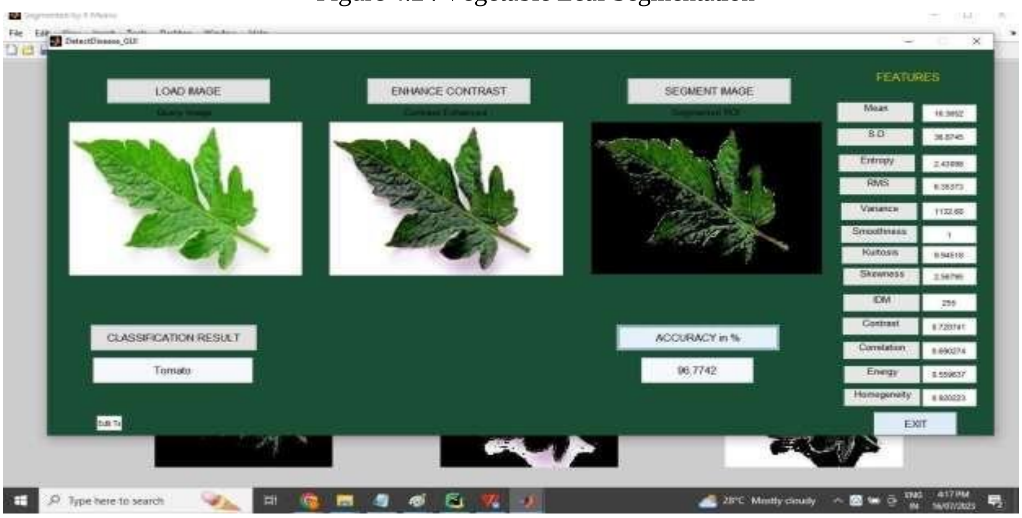

Figure 4.3: Vegetable Leaf Classification

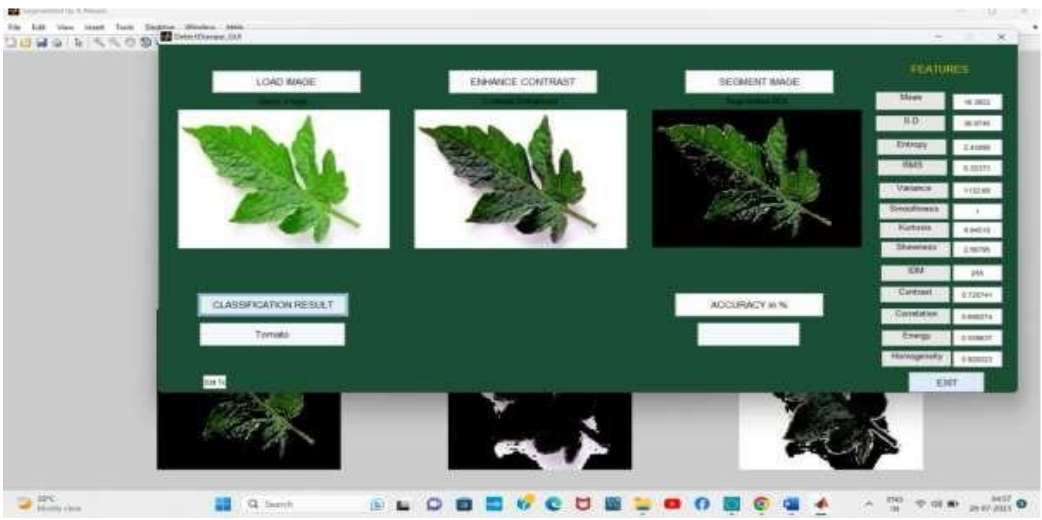

Figure 4.4: Tomato leaf Recognition Accuracy

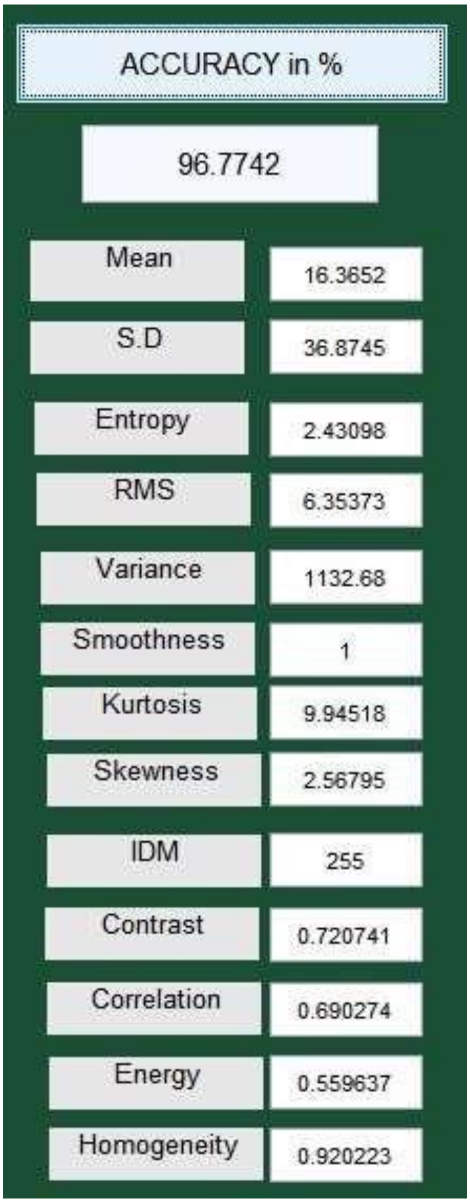

Figure 4.5 : Tomato leaf Recognition Accuracy

4.2 Test Cases

Test Number	Form	Description	Expected Result	Actual Result
1	Unit Test	Verify image preprocessing on leaf sample	Pre-processed image is obtained	Pre-processed image is obtained
2	Unit Test	Test feature extraction on leaf sample	Relevant features are extracted	Relevant feature are extracted

3	Unit Test	Validate classification on known leaf species	Correct species is identified	Correct species is identified
4	Integration Test	Verify seamless integration of preprocessing feature extraction, and classification modules	Components work together without errors	Components work together without errors
5	Validation Test	Evaluate recognition accuracy on	High accuracy in identification different	High accuracy in identifying different
		diverse vegetable leaf samples	vegetables species	vegetable species

5. Test Results

Test Result : 1

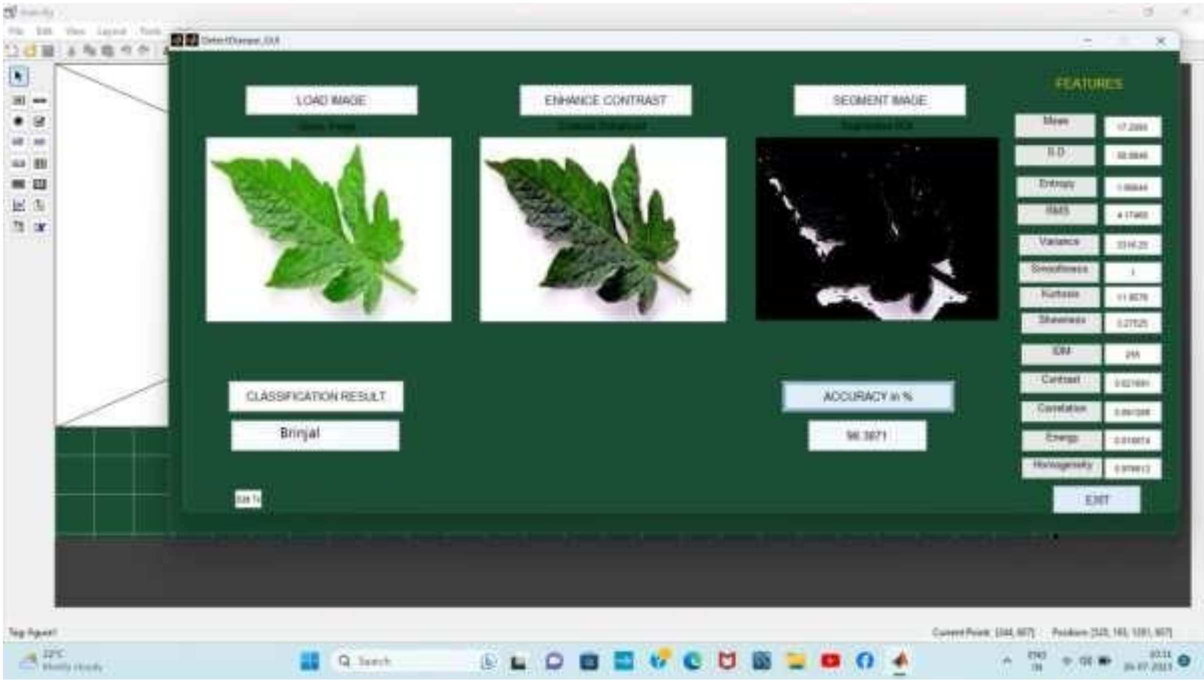

Figure 5.1 : Test result for tomato leaf

The test results for identifying tomato leaves revealed errors in the names certain tomato leaves were projected to have. Due to dissimilar and unsuitable training data, the model had difficulty generalising correctly, which resulted in errors in towards the dominant class. It's possible that overfitting had place, which affected the model's capacity to accurately identify fresh, unseen tomato leaves

Test Result : 2

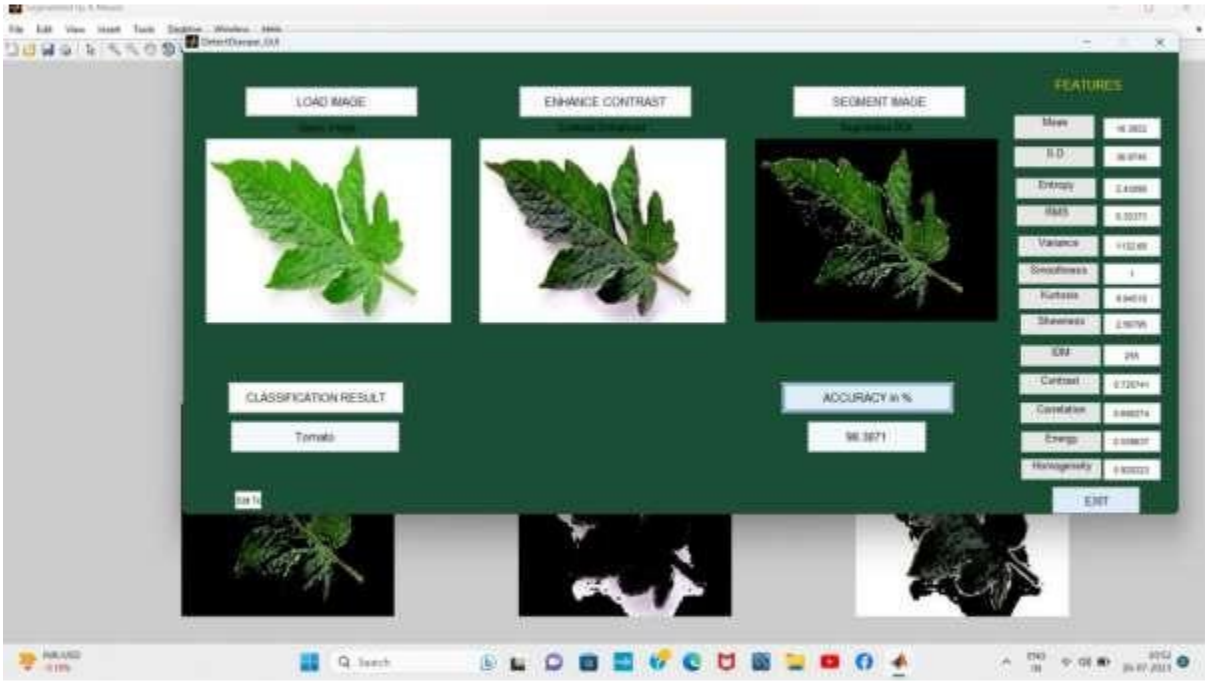

Figure 5.2 : Test result for tomato leaf

In this test result The leaf recognition system achieved this result by utilising a various image evaluating and ML techniques approaches. A expanded collection of photos of tomato leaves with related labels was first gathered and preprocessed to improve image quality and lower noise. The key attributes regarding the leaves were derived using feature extraction. techniques including colour histograms and texture analysis.

6. CONCLUSION

The method that has been suggested for leaf identification of vegetables using MATLAB provides an effective solution for automated identification and classification by processing images methods, feature extraction algorithms, and models regarding ML There are various benefits of this technology include quality control, increased agricultural process efficiency, and plant disease identification. When the technique is successfully implemented, farmers, researchers, and other agricultural experts will be able to quickly and easily identify vegetables depending based on the qualities of their leaves. To compile the physical property of the leaves, the suggested system used pre-processing, segmentation, feature extraction, and classification. And for collecting the the Leaf's physical attributes, it uses RGB to labspace, K- means, and GLCM. Future developments may concentrate on enhancing the system's capacity to handle various and complicated leaf patterns, adding real-time leaf identification capabilities, and extending the recognition system to a larger variety of vegetable species. Using MATLAB to recognise leaves has a lot of potential to improve farming methods, enable better plant management, and increase the production of healthy food. With a percentage of 96.77%, the suggested system's SVM algorithm will produce accurate results.

7. FUTURE ENHANCEMENT

The proposed system recognize vegetable leaf based on color texture and shape using SVM algorithm various methods for processing images. In future apply Deep Learning Methods, including as in convolutional neural networks (CNNs) or recurrent neural networks (RNNs), can be applied to identify leaves. Online and immediate identification To allow real- time recognition of vegetable leaves, improve the leaf recognition system. As a result, leaves in the field or on production lines can be quickly identified, allowing quick decisions and actions.

Multiple-spectral imaging Investigate use of multi-spectral imaging methods to compile more extensive data what is visible. Sensitive changes in leaf Features can be recorded by collecting data from a variety of spectral regions, enabling more precise and thorough detection. Leaf Disease Identification Add disease identification capabilities to the leaf recognition system. The system can help in the early diagnosis and treatment of plant conditions by the integration of disease detection algorithms with leaf recognition, This would improve plant health and agricultural yield.

BIBLIOGRAPHY

1. Chaki .J. and Parekh. R. 2012. designing an automated system for plant leaf recognition. Int. Journal of Advances in Engineering & Technology (IJAET). 149- 158.
2. Backes, A.R., Bruno, O.M. plant leaf identification using multi-scale fractal dimension. In: International Conference On Image Analysis And Processing. pp. 143–150. Springer Berlin nHeidelberg (2009)
3. Cope.James S, Remagnino.Paolo, Barman.Sarah, and Wilkin.Paul. 2010. plant texture classification using gabor co-occurrences. Springer. 669-677.
4. Beghin.T, Cope.J. S., Remagnino.P., & Barman.S. (2010). Shape and texture based plant leaf classification. International Conference on Advanced Concepts for Intelligent Vision Systems (ACVIS). volume 3, 345-353.
5. Arivazhagan, S., Ganesan, L., Priyal, S.P. Texture classification using Gabor wavelets based rotation invariant features.Volume 27, Issue 16, 76-82
6. Z. Ibrahim, N. Sabri and N. N. Abu Mangshor. leaf recognition using texture features for herbal plant identification, Indonesian J. Electr. Eng. Compute. Sci., vol. 9, pp. 152-156, 2018. https://doi.org/10.11591/ijeecs.v9.i1.pp152-156
7. M. Lukic, E. Tuba and M. Tuba. leaf recognition algorithm using support vector machine with hu moments and local binary patterns, in Proc. IEEE 15th Int. Symp. Appl. Mach. Intell. Inf., Slovakia, 2017, pp. 485-490.
8. H. X. Kan, L. Jin and F. L. Zhou. Classification of medical plant leaf image based on multi- feature extraction, Pattern Recog. Image Anal., Vol. 27, pp. 581-587, 2017. https://doi.org/10.1134/S105466181703018X
9. Du, J.X., Wang, X.F., Zhang, G.J.: Leaf shape based plant species recognition. Applied Mathematics and Computation 185, 883–893 (2007)
10. Priyanka Kulkarni, & Dr. Swaroopa Shastri. (2024). Rice Leaf Diseases Detection Using Machine Learning. Journal of Scientific Research and Technology, 2(1), 17–22. https://doi.org/10.61808/jsrt81
11. Shilpa Patil. (2023). Security for Electronic Health Record Based on Attribute using Block-Chain Technology. Journal of Scientific Research and Technology, 1(6), 145–155. https://doi.org/10.5281/zenodo.8330325
12. Mohammed Maaz, Md Akif Ahmed, Md Maqsood, & Dr Shridevi Soma. (2023). Development Of Service Deployment Models In Private Cloud. Journal of Scientific Research and Technology, 1(9), 1–12. https://doi.org/10.61808/jsrt74
13. Antariksh Sharma, Prof. Vibhakar Mansotra, & Kuljeet Singh. (2023). Detection of Mirai Botnet Attacks on IoT devices Using Deep Learning. Journal of Scientific Research and Technology, 1(6), 174–187.
14. Dr. Megha Rani Raigonda, & Shweta. (2024). Signature Verification System Using SSIM In Image Processing. Journal of Scientific Research and Technology, 2(1), 5–11. https://doi.org/10.61808/jsrt79

15. Shri Udayshankar B, Veeraj R Singh, Sampras P, & Aryan Dhage. (2023). Fake Job Post Prediction Using Data Mining. Journal of Scientific Research and Technology, 1(2), 39–47.
16. Gaurav Prajapati, Avinash, Lav Kumar, & Smt. Rekha S Patil. (2023). Road Accident Prediction Using Machine Learning. Journal of Scientific Research and Technology, 1(2), 48–59.
17. Dr. Rekha Patil, Vidya Kumar Katrabad, Mahantappa, & Sunil Kumar. (2023). Image Classification Using CNN Model Based on Deep Learning. Journal of Scientific Research and Technology, 1(2), 60–71.
18. Ambresh Bhadrashetty, & Surekha Patil. (2024). Movie Success and Rating Prediction Using Data Mining. Journal of Scientific Research and Technology, 2(1), 1–4. https://doi.org/10.61808/jsrt78
19. Dr. Megha Rani Raigonda, & Shweta. (2024). Signature Verification System Using SSIM In Image Processing. Journal of Scientific Research and Technology, 2(1), 5–11. https://doi.org/10.61808/jsrt79