International Journal of Aquatic Science
ISSN: 2008-8019
Vol 12, Issue 03, 2021

An Efficient Color Based Segmentation And Feature Extraction Framework For Leaf Disease Detection In Smart Agriculture

Padmapriya.J[1], Karthickmanoj.R[2], Dr.T.Sasilatha[3], Bharathi.V[4]

[1,2,3]Department of EEE,AMET Deemed to be University, Chennai,Tamil Nadu, India
[4] Department of ECE, Indian Institute of Information Technology, Trichy

Email: [1]priyajecay@gmail.com [2]karthickmanoj@ametuniv.ac.in,
[3]deaneeem@ametuniv.ac.in, [4]bharathiv.ece@gmail.com

ABSTRACT
Internet of Things and Artificial Intelligence has led to the advancements in smart agriculture to improve our country's economy. This paper focusses on developing an efficient framework for automatic detection of diseases in plant leaves during the onset of diseases. Timely detection and accurate identification of diseases is helpful in preventing the spread of the diseases thereby reducing the crop damage significantly. A novel color component based segmentation process is proposed in this work. To evaluate the performance of the developed algorithm Python IDE was used and metrics such as detection accuracy and classification accuracy were used.
Keywords: Plant disease, IOT, Segmentation, feature extraction, SVM.

1. INTRODUCTION

Smart agriculture in today's world plays a vital role with the help of Internet of Things and Artificial intelligence that improves crop productivity and farmers income [1,2]. Plant diseases has a great impact on crop yield by affecting the quality and quantity [3,4,5]. It is necessary to detect the diseases at an early stage and prevent the spreading of diseases by developing automatic systems for monitoring the plants. This automated system will serve as an accurate alternative for manual monitoring of farms by farmers. Hence this paper focuses on developing a novel color based segmentation and feature extraction (CSFE) framework for detecting the diseases in plant leaves at an early stage. The color transformation model is used for transforming the captured image into a color domain and segmentation and feature extraction is done for all the color components. Statistical measure-based segmentation and Oriented Fast and Rotated Brief features extraction is done.
The authors of [6] presented to improve the characteristics of maize from the framework they designed from the feature extracted in the maize leaf. Robust Alexnet was utilised in this study for in order to predict the feature accurately. The benefits include ease of usage and improved accuracy. Analysis and the real time data was not carried out for the extraction, which is a disadvantage.
FCM-KM and Faster R-CNN fusion were proposed by the authors in [7] for detecting difficulties in rice pictures. This work showed lack of accuracy in detection for the large scale planting with the trade-off complexity.
The authors of [8], [9] proposed a detection system for diseases in the plants by making use of compressed sensing and classification. The proposed study has been validated by the

authors through the results which are all shown for various plants. The categorization was done using SVM, which yielded a 98.5 percent accuracy.

In [10] the authors have proposed a segmentation algorithm based on genetic algorithm where SVM classifier was used for classification. The results show that the proposed work achieves a 95.71 % of detection accuracy and classification accuracy of about 97.6 %. M.Bhange et.al [11] developed a web-based tool for identifying pomegranate diseases by extracting features such as color and morphology. K-Means algorithm is used for segmentation and classification through SVM achieving 82 % accuracy. In [12, 13] the authors have developed automatic transmission of information through the wireless sensor networks.

The paper is organized in the flow as given. Section 2 explains about the proposed CSFE framework. Section 3 discusses about the simulation and its results. Finally, the conclusion and insight on future scope is given in section 4.

2. PROPOSED COLOR BASED SEGMENTATION AND FEATURE EXTRACTION FRAMEWORK

An efficient algorithm is developed for plant leaf disease detection for smart agriculture applications. The algorithm concentrates on accurate segmentation and feature extraction. In this framework a novel color component-based segmentation and feature extraction is done. Segmentation is done by computing the statistical measure-based threshold for all the color components separately. The framework of the proposed algorithm is shown in figure.1

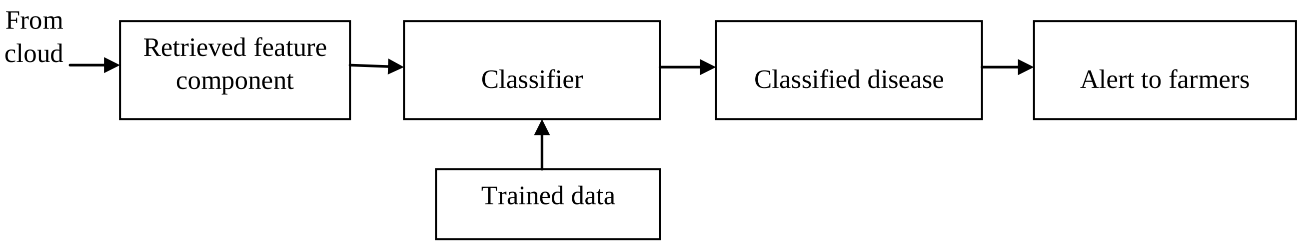


Figure 2 Process flow at monitoring site

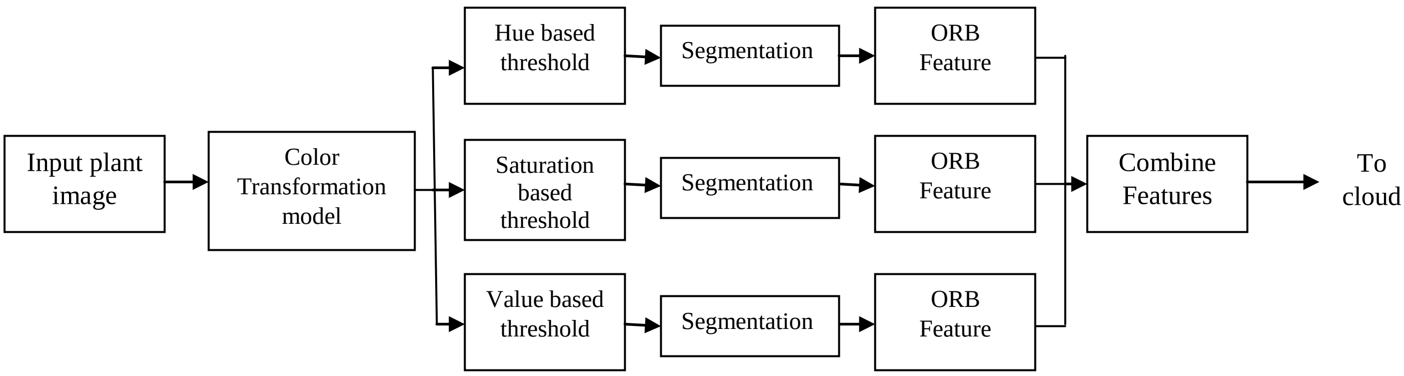


Figure 1 Transmission framework of the proposed algorithm

Each of the modules at transmission and monitoring sections are explained in detail as follows.

a) Image Acquisition and Pre-processing step:

The plant leaf images are captured using good resolution camera from the agricultural field. The captured image is contrast enhanced for improving the quality of the image and then color transformation model was used. RGB TO HSV color model transformation is used in this work.

b) Color Component based Segmentation:

The segmentation for each color component is done separately. Initially the mean and variance of the H, S and V component is computed as H_u, H_v, S_u, S_v, V_u, V_v respectively. The segmentation threshold of the color components are computed by adding the mean and variance of the each component as shown in equations (1),(2) and (3)

$T_H = H_u + H_v$ (1)

$T_S = S_u + S_v$ (2)

$T_V = V_u + V_v$ (3)

The segmentation of the diseased part for the color components is carried out by comparing the pixels with the respective thresholds.

c) Color Component based feature extraction

ORB feature detector is used in this work to extract ORB features from the segmented images of the H, S and V components. N features are detected from each of the component and finally the features are combined to form 3 N features. This combined feature component is send to the cloud for classification to the receiving unit.

d) Monitoring section

The cloud platform is used to get the feature component, which is then supplied to the classifier. The classifier is based on the support vector machine technique, which is initially trained using labelled data. The classified disease along with remedy for the problem is given as information to the farmers by the experts.

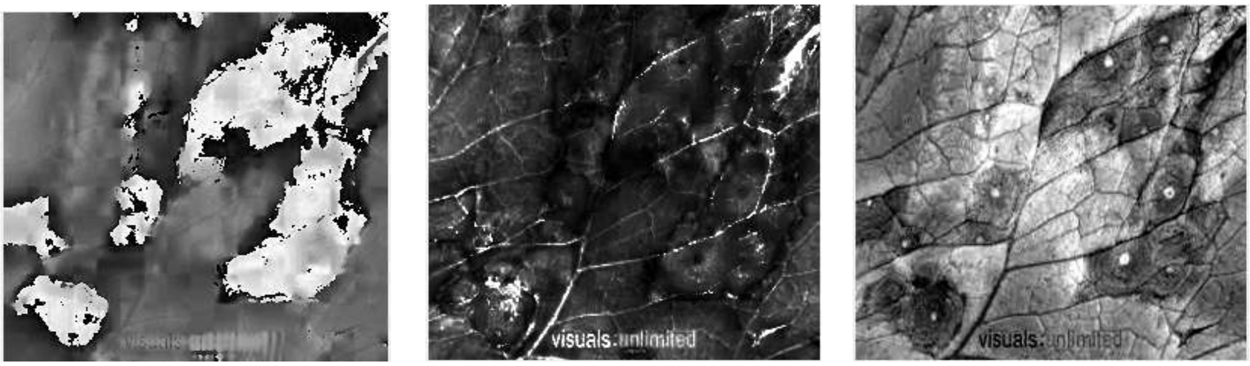
The proposed CSFE algorithm is implemented in the plant disease detection system which can efficiently improve the accuracy.

3. SIMULATION RESULTS AND DISCUSSION

The proposed algorithm is implemented in PYTHON software for validation as the algorithm was tested in Raspberry Pi board [11]. Raspbian jessie OS [12] was installed and python programming language was used. For evaluating the proposed algorithm database images were taken from [13,14]. Images of pomegranate plant leaves were considered and diseases like anthracnose, Alternaria Alternata and cercospora leaf spot was taken for classification. Both training and test images were taken from the database. SVM algorithm is used for classification [15]. Figure 3 shows the input images of the diseases leaves of the pomegranate plant. The input image is of size 256 x 256 which is in RGB format and converted to HSV using color transformation model. Segmentation threshold is derived for each of the components by computing the mean and variance. Once the disease affected part is segmented using the thresholds, ORB features are extracted. Five ORB features are extracted from each of the component which are combined to feature component of size 15 x 1. These features correspond to the test features for classification. Figure 4, 5 6,7,8 and 9 shows the HSV transformed and segmented images of H, S and V component respectively.

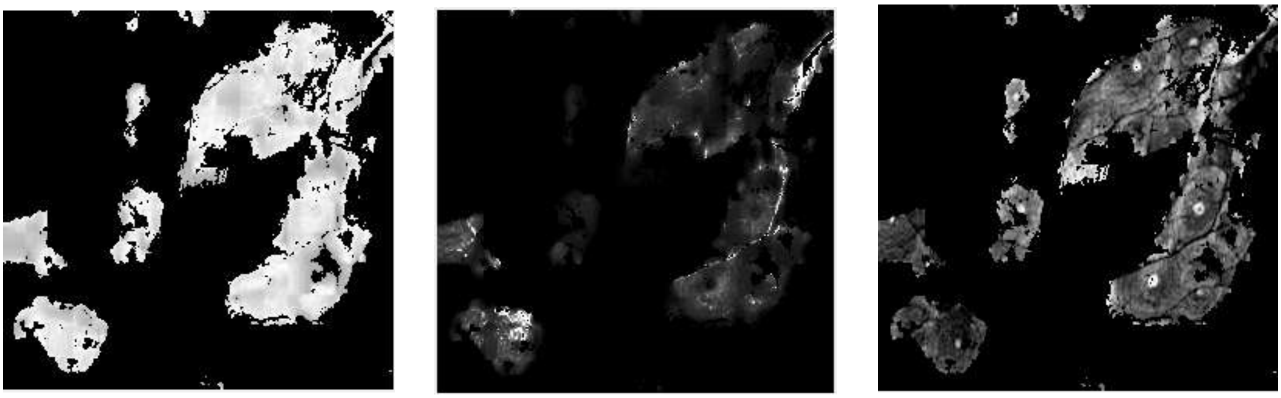
(a) (b) (c)

Figure 3 Input images of the diseased pomegranate plant a) Anthracnose, b) Alternaria Alternata, c) Cercospora leaf spot



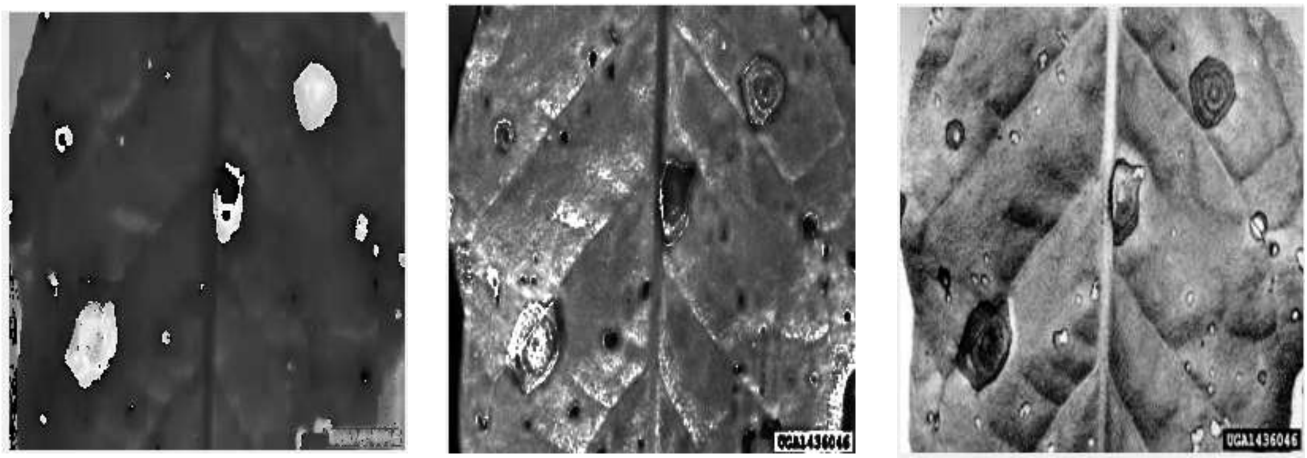
(a) (b) (c)

Figure 4 HSV transformed image of Anthracnose a) H component, b) S component, c) V component



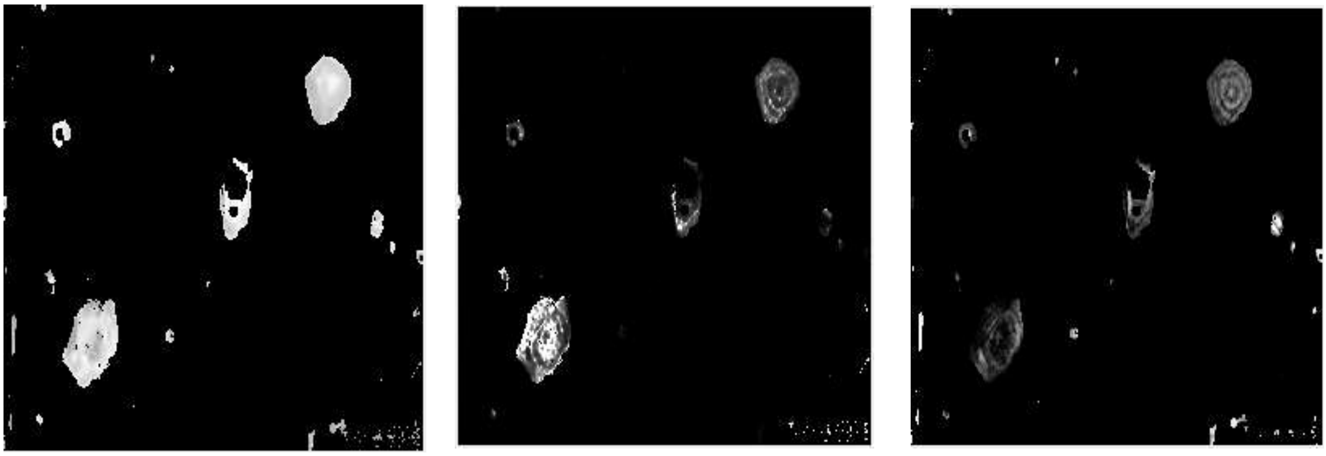
(a) (b) (c)

Figure 5 Segmented image of Anthracnose a) H component, b) S component, c) V component



(a) (b) (c)

Figure 6 HSV transformed image of Alternaria Alternata a) H component, b) S component, c) V component



(a) (b) (c)

Figure 7 Segmented image of Alternaria Alternata a) H component, b) S component, c) V component

(a) (b) (c)

Figure 8 HSV transformed image of Cercospora leaf spot a) H component, b) S component, c) V component

(a) (b) (c)

Figure 9 Segmented image of Cercospora leaf spot a) H component, b) S component, c) V component

a) Accuracy

Performance of the system and the algorithm which is been proposed will be validated by the Detection accuracy in terms of early detection of diseases. Figure 10 shows the bar chart of obtained detection accuracy for different diseases of pomegranate plants.

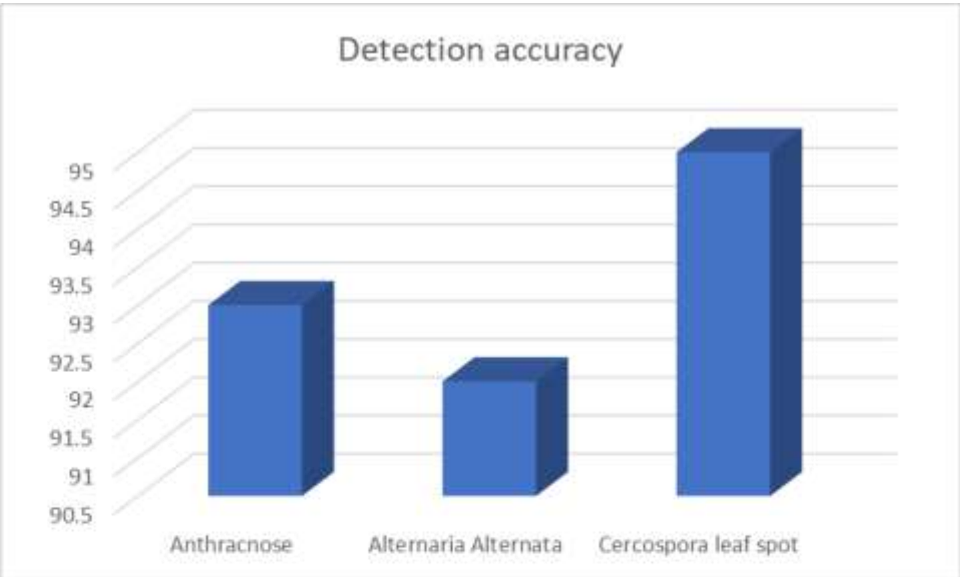


Figure 10 Detection accuracy of the CSFE Framework

Diseases	Features extracted	Classification accuracy (%)
Anthracnose	15	90
	45	90.6
	90	91.6
Alternaria Alternata	15	91.5
	45	91.9
	90	92.8
Cercospora leaf spot	15	92.6
	45	93.1
	90	94
Overall detection accuracy (%)	15	91.4
	45	91.9
	90	92.8

Table. 1 Classification accuracy of the proposed CSFE framework

The suggested CSFE framework is estimated to have the accuracy of 93.3 percent in detection and the accuracy is of about 91.4 percent , 91.9 percent, and 92.8 percent for features of sizes 15, 45, and 90, respectively for classification. The bar chart and table clearly show that the suggested framework's overall accuracy is higher than that of the existing methodologies stated in [9] and [10].

4. CONCLUSION AND FUTURE WORK

Disease detection in plant is a critical issue that must be solved as soon as possible in order to strengthen the country's economy. This work adds to the development of a color-based segmentation and feature extraction system for disease diagnosis and classification that is quick and accurate. The image is captured from the field and then transformed from RGB to HSV, with segmentation thresholds calculated from each of the modified components. The sick part is segmented using the segmentation thresholds, and then ORB features are retrieved and merged into a single feature component. The feature component is sent to the cloud and retrieved using SVM for classification. The information on the classified disease and solution is provided to farmers by experts. The framework was validated in raspberry pi board and python software. For demo purpose database from internet was considered.
In future the algorithm can be optimized in terms of the number of features to be extracted for accurate detection and classification. The algorithm can be validated using real time hardware and the deployed in field.

5. REFERENCES

[1]. Upadhyay, Anand, Amit Upadhyay, and Sunita Maurya. "Regression and artificial neural network based improved classification of LISS-III satellite image." In 2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC), pp. 917-921. IEEE, 2017.
[2]. Shanthi, H. J, and EA Mary Anita. "Heuristic approach of supervised learning for intrusion detection." Indian Journal of Science and Technology 7 (2014): 11.

[3]. Khirade, Sachin D., and A. B. Patil. "Plant Disease Detection Using Image Processing." In Computing Communication Control and Automation (ICCUBEA), 2015 International Conference on, pp. (768-771). IEEE, (2015).
[4]. Linda, G. Merlin, G. Themozhi, and Sudheer Reddy Bandi. "Color-mapped contour gait image for cross-view gait recognition using deep convolutional neural network." International Journal of Wavelets, Multiresolution and Information Processing 18, no. 01 (2020): 1941012.
[5]. Themozhi, G., and S. Rama Reddy. "Output Voltage Regulation in ZVS Bidirectional DC to DC Converter Using Neural Network." IUP Journal of Electrical & Electronics Engineering 5, no. 3 (2012).
[6]. M. Lv, G. Zhou, M. He, A. Chen, W. Zhang and Y. Hu, "Maize Leaf Disease Identification Based on Feature Enhancement and DMS-Robust Alexnet," in IEEE Access, vol. 8, pp. 57952-57966, 2020, doi: 10.1109/ACCESS.2020.2982443.
[7]. G. Zhou, W. Zhang, A. Chen, M. He and X. Ma, "Rapid Detection of Rice Disease Based on FCM-KM and Faster R-CNN Fusion," in IEEE Access, vol. 7, pp. 143190-143206, 2019, doi: 10.1109/ACCESS.2019.2943454.
[8]. Aasha Nandhini S; Hemalatha R; Radha S; Indumathi K; “Web Enabled Plant Disease Detection System for Agricultural Applications using WMSN”, Springer’s Wireless Personal Communications, Published online, pp. 1-16, December 2017.
[9]. R Dorothy, S Sasilatha, (2017) “Smart Grid Systems Based Survey on Cyber Security Issues”, Bulletin of Electrical Engineering and Informatics 6 (4), 337-342
[10]. Singh, Vijai, and A. K. Misra. "Detection of plant leaf diseases using image segmentation and soft computing techniques."Information Processing in Agriculture (2016).
[11]. Bhange, Manisha, and H. A. Hingoliwala. "Smart Farming: Pomegranate Disease Detection Using Image Processing." Procedia Computer Science 58 (2015): (280-288).
[12]. Veerakumar P., Dheepak M., Saravanan S.V. “PLC based automatic control for onboard ship gangway conveyor system” International Journal of Mechanical Engineering and Technology Volume 8, Issue 3.
[13]. Dr.T.Sasilatha, “Autonomous and manual voice operated fire fighting Robot”, International journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE), Volume 2, Issue 6, 2016.
[14]. https://www.raspberrypi.org/products/raspberry-pi-3-model-b
[15]. https://www.raspberrypi.org/blog/raspbian-jessie-is-here
[16]. http://agritech.tnau.ac.in/horticulture/horti_index.html
[17]. https://www.uaex.edu/yard-garden/resource-library/diseases
[18]. Surendiran, J., S. V. Saravanan, and K. Kmanivannan. "Detection of glaucoma based on color moments and SVM classifier using k mean clustering." International Journal of Pharmacy and Technology 8, no. 3 (2016): 16139-16148.
[19]. M Parameswari, T Sasilatha, (2018)"Cross-layer based error control technique for WSN with modified relay node selection and corruption aware method" Wireless Personal Communications 99 (1), 479-495
[20]. A Priya, T Sasilatha (2017) "Wireless network for strategic boundary supervision system" Bulletin of Electrical Engineering and Informatics 6 (4), 367-370