Disease Detection of Paddy Crops Using UAV Image Analysis

S. Meivel[1], G.Kalaiarasi[1], P.Brindha[2], K.Kowsalya[2], C.Jibetha Veerakumari[2],

[1]Assistant Professor, Department of Electronics and Communication Engineering, Jay Shriram Group of Institutions, Tirupur, Tamilnadu, India

[2] Final year, Department of Electronics and Communication Engineering, Jay Shriram Group of Institutions, Tirupur, Tamilnadu, India

ABSTRACT: The plant disease identification is one of the most basic and important activities in agriculture. A plant disease on the other hand is defined as impairment of the normal physiological functioning of a plant or plant part, caused by disease causing agents such as fungi, bacteria, viruses, phyto plasmas viroids, etc. These are the disease affecting this paddy crops and the impact of plant diseases are reducing the yield and farmers investment. Due to this, they minimize the enhancement of agriculture towards the growth. Insecticides are not always proved efficient and good for the soil. Early detection of insects and diseases can reduce the amount of insecticides. Many types of symptoms associated with discolored crops have been observed on paddy. It is difficult for farmers to identify the symptoms of the diseases and to take right remedy. So, they need a technology development tool identify the diseases at the starting stage one of those tool is MATLAB.

Using hardware component of the Arducam ESP8266 UNO Board and OV2640 Arducam mini module is used to control and capture the image of affected area and the captured image can be transferred to PC via Wi-Fi connection and it can provide some feature extraction. Identification of the plant diseases is the key to protect the crops. It saves a lot of man power, increases quality with quantity. This paper introduces a calculation for picture division strategy which is utilized for programmed location and order of plant leaf maladies. It moreover covers study on various sicknesses arrangement systems that can be utilized for plant leaf ailment recognition. Picture division, which is an essential viewpoint for sickness identification in plant leaf ailment, is finished by utilizing hereditary calculation.

KEYWORDS: Arducam Wi-fi, Matlab, Segmentation algorithm, Segmentation, Feature Extraction

I. INTRODUCTION

The Indian agricultural land process is more than just being a feeding sourcing in today's world. Indian economy is highly dependent of agricultural productivity. Therefore in field of agriculture, detection of disease in Paddy crops plays an important role. To detect a plant disease in very initial stage, use of automatic disease detection technique is beneficial. In case a Disease named little leaf ailment is a perilous malady found in pine trees in United States. The influenced tree has a hindered development and passes on inside 6 years. Its effect is found in Alabama, Georgia parts of Southern US. In such situations early recognition could have been productive. The current technique for plant sickness location is essentially exposed eye perception by specialists through which recognizable proof and recognition of plant ailments is finished. For doing as such, a substantial group of specialists and in addition nonstop checking of plant is required, which costs high when we do with vast ranches. In the meantime, in a few nations, agriculturists don't have legitimate offices or even thought that they can contact to specialists. Because of which counselling specialists even cost high and in addition tedious as well. In such conditions, the proposed system turns out to be advantageous in checking extensive fields of yields. Programmed identification of the infections by simply observing the side effects on the plant leaves makes it less demanding and in addition less expensive. This additionally

underpins machine vision to give picture based programmed handle control, investigation, and robot direction [2,4,5]. Plant infection distinguishing proof by visual way is more relentless undertaking and in the meantime, less exact and should be possible as it were.

The provincial land mass is more than essentially being a reinforcing sourcing nowadays. Indian economy is significantly penniless of country productivity. Thusly in field of agriculture, acknowledgment of illness in Paddy crops accepts a basic part. To recognize a plant ailment in incredibly initial stage, usage of modified disease area technique is useful. For instance an illness named little leaf contamination is a perilous affliction found in pine trees in United States. The impacted tree has an obstructed advancement and fails miserably inside 6 years. Its impact is found in Alabama, Georgia parts of Southern US. In such circumstances early disclosure could have been gainful.

Horticultural profitability is something on which economy very depends. This is the one of the reasons that illness location in Paddy crops assumes a critical part in agribusiness field, as having illness in Paddy crops are very normal. In the event that appropriate care is not taken around there then it causes genuine impacts on Paddy crops and because of which particular item quality, amount or efficiency is influenced. For example an infection named little leaf sickness is a risky malady found in pine trees in United States. Identification of plant infection through some programmed method is gainful as it diminishes a vast work of checking in enormous ranches of crops, and at early stage itself it identifies the manifestations of illnesses i.e. when they show up on plant clears out.

The current technique for plant ailment location is basically exposed eye perception by specialists through which recognizable proof what's more, discovery of plant illnesses is finished. For doing as such, a vast group of specialists and also ceaseless checking of plant is required, which costs high when we do with expansive ranches. In the meantime, in a few nations, ranchers try not to have legitimate offices or even thought that they can contact to specialists. Because of which counselling specialists even cost high and in addition tedious as well. In such conditions, the recommended method ends up being valuable in checking substantial fields of harvests. Programmed recognition of the ailments by simply observing the manifestations on the plant leaves makes it less demanding and additionally less expensive. This likewise underpins machine vision to give picture based programmed prepare control, assessment, and robot direction [2,4,5]. Plant infection recognizable proof by visual way is more difficult assignment and in the meantime, less precise and should be possible as it were

II. LITERATURE REVIEW

Mama et al., [1] makes a survey on the present division calculations utilized for medicinal pictures. Calculations chiefly classes in three classifications as indicated by their primary ideas: the initially in view of edge, the second in light of example acknowledgment systems and third one in view of deformable models. Lately the third classification of calculations is concentrated on deformable models subsequently of escalated examination. A portion of the fundamental utilizations of these calculations are dividing organs and tissues in pelvic depression region. These are examined through a few preparatory examinations. Creators in paper [2], characterized a calculation on the premise of the vital approachs. Calculations of every class are talked about and the essential thoughts, application fields, points of interest and detriments of every classification are outlined.

Tests that utilization these calculations to portion the tissues and organs of the female pelvic cavity are to appear their interesting attributes. In the last, the imperative rule s for planning the division calculations of the pelvic pit are proposed. Tavares portrays that the computational investigation of pictures is trying because of errands, for example, division, extraction of delegate elements, coordinating, arrangement, following, movement investigation, misshapening estimation, and 3D remaking. In paper [3], the techniques for preparing what's more, examining articles in pictures and their utilization in applications like pharmaceutical, biomechanics, building and materials sciences are proposed.

The current techniques studies are for expanding throughput and lessening subjectiveness which comes because of stripped eye perception through which identification and recognition of plant sicknesses is finished. As per [5] delicate registering techniques, for example, counterfeit neural systems (ANN), hereditary programming, and fluffy rationale can be utilized as an option strategy for demonstrating complex conduct of materials, for example, graphene. These calculations require input preparing information for taking care of issues. These registering strategies create important answers for entangled advancement issues in light of the info. In numerous models bolster forward system of three layers can be utilized.

Root-mean-square blunder strategy can be utilized to decide the quantity of neurons in shrouded layer. Tabu pursuit is the meta heuristic inquiry technique which utilizes nearby look systems utilized for scientific enhancement. Nearby quests get an answer for an issue which is potential and checks its prompt neighbors i.e. those arrangements which are comparative with the exception of some minor subtle elements, with a goal of finding a superior arrangement. Nearby look strategies have a tendency to stall out in imperfect locales or on levels where numerous arrangements are similarly fit. In the event that any arrangement which is potential has been already gone to inside a brief span or on the off chance that it doesn't fulfils a govern, then it is stamped as "tabu". Thusly, the calculation doesn't consider that probability rehashed [4].

Hereditary calculations were utilized to develop projects to perform certain errands by John Koza in 1992. His technique was known as "hereditary programming" (GP). Hereditary programming is thought to be the most celebrated for unravelling typical relapse issues and is broadly utilized for unravelling advancement issue. The working guideline behind GP and GA are same yet there falsehoods a noteworthy contrast between the two that GP gives arrangements as far as weighted entirety of coefficients, though GA gives arrangements spoke to by a number in paired or, on the other hand genuine shape. In this manner, we can state that GP is a structure improvement technique while GA is a parameter advancement strategy.

MGGP is the Genetic programming in which transformative stage is a joined arrangement of a few trees which are relapsed utilizing slightest squares strategy. We can utilize experimentation strategy for the successful usage of MGGP [6,7,9]. Vijayaraghavan et al. in their work [8] expressed that a support vector machine is an exceptionally potential AI strategy and can apply broadly to take care of grouping issues. The SVM which is utilized to take care of relapse issues is known as bolster vector relapse (SVR). SVR is extremely prevalent among scientists for giving speculation capacity to the arrangement display. The indication of pathogens in manors is the one of the most essential reason for misfortunes in many harvests. Bernardes et al. give the strategy for the programmed arrangement of cotton infections in light of the component extraction of foliar side effects from advanced pictures. For the component extraction this strategy utilizes the vitality of the wavelet change and a SVM for the real arrangement [10].

Ghaiwat et al. presents overview on various grouping systems that can be utilized for plant leaf infection grouping. For given test case, k-closest neighbor technique is appears to be appropriate and also least complex of all calculations for class expectation. In the event that preparation information is not straightly distinct then it is hard to decide ideal parameters in SVM, which shows up as one of its downsides [16]. Creators in paper [17] depict that there are principally four ventures in created preparing plan, out of which, first one is, for the info RGB picture, a shading change structure is made, in light of the fact that this RGB is utilized for shading era also, changed or changed over picture of RGB, that is, HSI is utilized for shading descriptor. In second step, by utilizing limit esteem, green pixels are covered and evacuated. In third, by utilizing pre-registered limit level, evacuating of green pixels also, covering is accomplished for the valuable portions that are extricated first in this progression, while picture is sectioned. Furthermore, in last or fourth fundamental stride the division is finished.

Mrunalini et al. [18] presents the method to arrange and distinguish the diverse ailment through which plants are influenced. In Indian Economy a Machine learning based acknowledgment framework will turn out to be extremely valuable as it spares endeavors, cash and time as well. The approach given in this for highlight set extraction is the shading co-event technique. For programmed location of infections in leaves, neural systems are utilized. The approach proposed can altogether bolster an precise location of leaf, and is by all accounts imperative approach, in the event of steam, and root ailments, putting less endeavors in calculation.

As per paper [19] ailment recognizable proof process incorporate a few stages out of which four primary strides are as per the following: in the first place, for the information RGB picture, a shading change structure is taken, and afterward utilizing a particular limit esteem, the green pixels are veiled and evacuated, which is further taken after by division prepare, and for getting valuable fragments the surface insights are figured. Finally, classifier is utilized for the components that are separated to characterize the illness.

The vigor of the proposed calculation is demonstrated by utilizing test consequences of around 500 plant leaves in a database. Kulkarni et al. presents a procedure for ahead of schedule and precisely plant illnesses discovery, utilizing fake neural system (ANN) and different picture preparing methods. As the proposed approach depends on ANN classifier for grouping furthermore, Gabor channel for highlight extraction, it gives better outcomes with an acknowledgment rate of up to 91%. An ANN based classifier arranges distinctive plant illnesses and utilizations the mix of surfaces, shading and components to perceive those maladies [20].

Creators display malady discovery in Malus domestica through a successful technique like K-mean grouping, surface what's more, shading investigation [21]. To order and perceive distinctive horticulture, it utilizes the surface and shading highlights those for the most part show up in ordinary and influenced regions. In coming days, for the reason for grouping K-implies bunching, Bayes classifier furthermore, essential part classifier can likewise be utilized.

As indicated by [22] histogram coordinating is utilized to distinguish plant illness. In plants, ailment shows up on leaf in this manner the histogram coordinating is done on the premise of edge location system and shading highlight. Layers partition strategy is utilized for the preparation procedure which incorporates the preparation of these examples which isolate the layers of RGB picture into red, green, and blue layers and edge recognition strategy which distinguishing edges of the layered pictures. Spatial Graylevel Reliance Matrices are utilized for building up the shading co-event surface examination strategy. Investigation of different calculations is given in Table 1.1.

Paper [23] presents the triangle limit and straightforward limit techniques. These strategies are utilized to sore district region and fragment the leaf region individually. In definite stride, arrangement of infection is finished by ascertaining the remainder of leaf region and injury region. As per the exploration done, the given strategy is quick and exact for figuring leaf sickness seriousness and leaf zone computation is finished by utilizing limit division.

Creators portray a calculation for malady spot division in plant leaf utilizing picture handling strategies [24]. In this paper, procedure of sickness spot identification is finished by looking at the impact of HSI, CIELAB, and YCbCr shading space. For Picture alleviating Median channel is utilized. In definite stride, by applying Otsu strategy on shading part, figuring of edge should be possible to discover the sickness spot. There is some commotion due to foundation which is appeared in the exploratory result, camera blaze and vein. CIELAB shading model is utilized to evacuate that clamor. The condition of workmanship audit of various techniques for leaf malady discovery utilizing picture preparing methods is introduced in paper [25].

A survey and research proposal of plant leaf disease diagnosis and classification on mobile devices :

Image classification on limited devices such as cellular phone is difficult because its limited capability to process, and storage using various classifier such as SVM, PNN etc., Hence we have propose a solution of these problem using cluster analysis technique which does not require any pre- training for classify the image and also it require limited memory to store the data.

Off-device image processing approaches:

Owing to the limited computing capacity on mobile phones and PDAs, there are diverse approaches to dealing with this issue, of which the most significant will be server-client based system. The user captures an image using mobile device, which is next sent to a server that bring out the actual processing work. Later than processing, the respond is sent back to the user via the mobile phone networks .In this approach only the mobile device can be used to capture the plant image, sending the image to the server, this require high cost and time to transfer the image to the server.

On-device segmentation approaches:

In "Multi-resolution mobile vision system for plant leaf disease diagnosis" [7] the authors Shitala Prasad , Sateesh K. Peddoju and DebashisGhosh proposed a mobile client–server architecture for Plant leaf disease detection and diagnosis using a novel combination of Gabor wavelet transform (GWT) and gray level co-occurrence matrix (GLCM). The system is a symbol of diseased patch in multi-resolution and multi-direction feature vector. The proposed system consists of two modules such as Mobile Client and Pathology Sever. In the first module, the images of the plant leaf has captured by mobile camera and pre-processes the leaf image, segments diseased patches in the mobile device itself and the segmented portion is transmits to the Pathology Sever for diseases detection. In the second module, Pathology Sever, receive the segmented portion of the image and extract the features using a novel combination of Gabor Wavelet Transform (GWT) and Gray Level Co-occurrence Matrix (GLCM), finally the classifier k-Nearest Neighbor classifies the segmented portion to diagnosis the disease that appear inthe portion of segmentation.

Data set:

In this casethey were focus into the most importantdiseases for example "blast," "helminthosporiose," "stemrot" and "foot rot".

Benefits to farmers:

1. Easy access to specialized Agriculture services byrural, under served, semi urban and in remote areas
2. Early diagnosis and quick treatment
3. Reduced visits to fields
4. Reduced travel expenses
5. Reduced burden of disease

III. PROPOSED METHODOLOGY
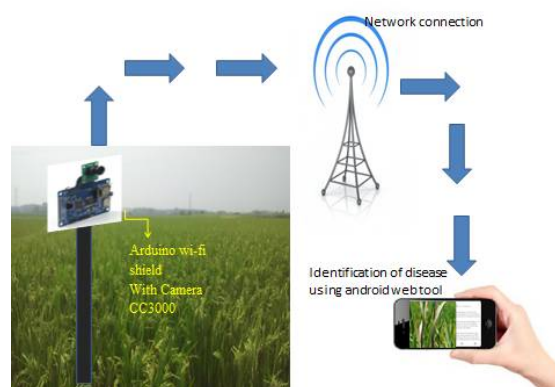
Advanced camera or comparable gadgets are use to take pictures of leafs of various sorts, and after that those are utilized to recognize the influenced range in leafs. At that point distinctive sorts of image processing systems are connected on them, to handle those pictures, to get diverse and helpful elements required for the motivation behind investigating later.

Calculation composed beneath represented the well ordered approach for the proposed picture acknowledgment and division forms:

(1) Image obtaining is the initial step that requires catching a picture with the assistance of a computerized camera.

(2) Pre-processing of information picture to enhance the nature of picture and to expel the undesired contortion from the picture. Cut-out of the leaf picture is performed to get the intrigued picture district and after that picture smoothing is done utilizing the smoothing channel. To increment the difference Image improvement is additionally done.

(3) Mostly green shaded pixels, in this progression, are covered. In this, we registered an edge esteem that is utilized for these pixels. At that point in the accompanying way for the most part green pixels are covered: if pixel force of the green part is not exactly the pre-figured limit esteem, at that point zero esteem is appointed to the red, green and blue segments of the this pixel.

(4) In the contaminated bunches, inside the limits, expel the conceal cells.

(5) Obtain the valuable portions to arrange the leaf sicknesses.

Fragment the segments utilizing hereditary calculation For doing bunching suitably, the inquiry ability of GAs can be utilized, to set of unlabeled focuses in N-measurement into K bunches. On picture information, we have connected a similar thought in our proposed conspire. We have taken a shading picture of size m n and each pixel has Red, Green and Blue segments. Each chromosome demonstrates an answer, which is a succession of K bunch focuses. Populace is introduced in different rounds haphazardly and from existing chromosome best chromosome makes due in each round for the following round preparing. In the initial step of wellness calculation the dataset of pixel is grouped by closest individual bunch focuses with the end goal that every pixel xi of shading picture is put into the particular group with bunch focus zj for j = 1, 2, ..., K by the accompanying conditions.

Constraint of existing work:

The execution still needs in exactness of result in a few cases. More streamlining is needed. Priori data is required for division. Database augmentation is required keeping in mind the end goal to come to the more exactness. Very couple of ailments have been secured. In this way, work needs to be stretched out to cover more maladies. The conceivable reasons that can prompt misclassifications can be as per the following: malady manifestations shifts from one plant to another, highlights streamlining is required, additional preparation tests are required keeping in mind the end goal to cover more cases and to foresee the illness all the more precisely. To expel these examination crevices another procedure for programmed recognition and additionally order of plant leaf infections utilizing picture division has been proposed.

**The favourable circumstances of proposed calculation are as per the following:**

1. Utilization of estimators for programmed Initialization of bunch focuses so there is no need of client contribution at the season of division.

2. The discovery exactness is improved with proposed calculation.

3. Proposed technique is completely programmed while existing strategies require client contribution to choose the best division of input picture.

4. It likewise gives condition neighborly recuperation measures of the distinguished sickness.
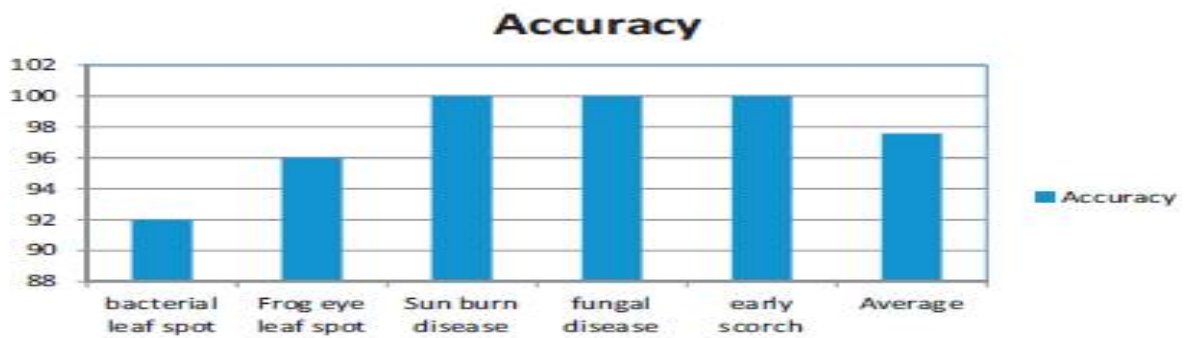
Classification results per class for proposed method.

Leaf disease	Bacterial leaf spot	Frog eye leaf spot	Sun burn disease	Fungal disease	Early scorch	Accuracy
Bacterial leaf spot	23	2	0	0	0	92
Frog eye leaf spot	1	24	0	0	0	96
Sun burn disease	0	0	25	0	0	100
Fungal disease	0	0	0	25	0	100
Early scorch	0	0	0	0	25	100
Average						97.6

S.No	Common name	Scientific name	Description	Image
1.	Bacterial blight.	Xanthomonas oryzaepv.oryzae	Lesions near the leaf tip or margin and start as water soaked in appearance; lesions, several inches long, turn white to yellow andthen gray due toaprophytic fungi.	
2.	Bacterial leaf Streak		Leaf streak lesions are usually thinner than those of narrow brown spot. Narrow brown spot lesions are not translucent, nor do they produce bacterial ooze	
3.	Foot rot	Erwiniachrysanthemi	In the early stages of the disease, brown sheath rot appeared that seemed to spread from the ligule regions. The lesions quickly extended down to nodes, culms, and finally to crowns. Neighboring tillers of the same crown were invaded systemically, causing foot rot symptoms.	

4.	Grain rot	Burkholderiaglumae	Bacterial grain rot symptoms appear on seedlings and spikelets. Seedlings raised in boxes turn brown and rot. The glumes (lemma) of infected spikelets are discolored. Initially dirty gray, they turn yellow brown , than become dark brown and shrunken, and ultimately dry.	
4.	Grain rot	Burkholderiaglumae	Bacterial grain rot symptoms appear on seedlings and spikelets. Seedlings raised in boxes turn brown and rot. The glumes (lemma) of infected spikelets are discolored. Initially dirty gray, they turn yellow brown , than become dark brown and shrunken, and ultimately dry.	

IV. RESULTS

Every one of the examinations are performed in MATLAB. For info information ailment, tests of plant leaves like rose with bacterial ailment, beans leaf with bacterial malady, lemon leaf with Sun consume ailment, leaf with early burn ailment and contagious malady in Paddy Crops leaf are considered. It demonstrates the unique pictures which are trailed by yield sectioned pictures. Sectioned picture can be arranged into various plant infections. The information and yield picture where input picture is a banana leaf with early singe sickness and yield picture demonstrates the order of sickness utilizing highlight extraction technique. The co-event components are computed in the wake of mapping the R, G, B segments of the info picture to the thresholded pictures. The co-event highlights for the leaves are extricated and contrasted and the comparing highlight values that are put away in the component library. The order is first done utilizing the Minimum Distance Criterion with K-Mean Clustering and demonstrates its productivity with precision of 86.54%. The location precision is enhanced to 93.63% by proposed calculation. In the second stage characterization is finished utilizing SVM classifier and demonstrates its productivity with exactness of 95.71%. Presently the location precision is enhanced to 95.71% by SVM with proposed calculation. The preparation and the testing sets for each kind of leaf alongside their recognition precision . From the outcomes it can be seen that the recognition precision is upgraded by SVM with proposed calculation contrasted with different methodologies detailed in [4,5,7].

The quantities of leaf infection tests that were arranged into five classes of leaf infection utilizing proposed calculation . From the outcomes it can be seen that lone few specimens from Frog eye leaf spot and bacterial leaf spot leaves were misclassified. Just two leafs with bacterial leaf spot illness are delegated frog eye leaf spot what's more, one frog eye leaf spot is order as bacterial leaf spot.

V. CONCLUSION

This paper exhibits the study on various maladies characterization strategies utilized for plant leaf ailment identification and a calculation for picture division strategy that can be utilized for programmed location and in addition grouping of plant leaf ailments of paddy crop are some of those ten species on which proposed calculation is

tried. Along these lines, related ailments for these plants were taken for distinguishing proof. With less computational endeavours the ideal outcomes were acquired, which likewise demonstrates the effectiveness of proposed calculation in acknowledgment and characterization of the leaf illnesses. Another favourable position of utilizing this strategy is that the plant illnesses can be distinguished at early stage or the underlying arrange. To enhance acknowledgment rate in arrangement handle Counterfeit Neural Network, Bayes classifier, Fuzzy Logic and half and half calculations can likewise be utilized.

REFERENCES

[1] Zhen ma, tavares jmrs, natal jorge rm, a review on the Current segmentation algorithms for medical images. In: 1st International conference on imaging theory and applications (imagapp), portugal; 2009. P. 135–140, isbn: 978-989-8111-68-5.

[2] Ma z, tavares jm, jorge rn, mascarenhas t. A review of Algorithms for medical image segmentation and their Applications to the female pelvic cavity. Comput methods Biomechan biomed eng 2010;13(2):235–46.

[3] Tavares jmrs, image processing and analysis: applications And trends, aes-atema'2010, fifth international conference, Canada, june 27–july 03; 2010. Pp. 27–41, isbn: 978-0-9780479- 7-9.

[4] Glover fred. Tabu search for nonlinear and parametric Optimization (with links to genetic algorithms). Discrete appl Math 1994;49:231–55.

[5] Al-bashish d, braik m, bani-ahmad s. Detection and Classification of leaf diseases using kmeans-based Segmentation and neural-networks-based classification. Inform technol j 2011;10:267–75.

[6] Beucher s, meyer f. The morphological approach to Segmentation: the watershed transforms. In: dougherty er, Editor. Mathematical morphology image processing, vol.12. New york: marcel dekker; 1993. P. 433–81.

[7] Bhanu b, lee s, ming j. Adaptive image segmentation using a Genetic algorithm. Ieee trans syst man cybern dec 1995;25:1543–67.

[8] Bhanu b, peng j. Adaptive integrated image segmentation and Object recognition. Ieee trans syst man cybern part c 2000;30:427–41.

[9] Woods keri. Genetic algorithms: colour image segmentation Literature review, 2007.

[10] Vijayaraghavan venkatesh, garg akhil, wong chee how, tail Kang, bhalerao yogesh. Predicting the mechanical Characteristics of hydrogen functionalized graphene sheets Using artificial neural network approach. J nanostruct chem. 2013.

[11] Garg akhil, garg ankit, tai k. A multi-gene genetic Programming model for estimating stress-dependent soil Water retention curves. Comput geosci 2014.

[12] Garg akhil, garg ankit, tai k, sreedeep s. An integrated srmmulti-Gene genetic programming approach for prediction of Factor of safety of 3-d soil nailed slopes. Eng appl artif intell 2014;30:30.

[13] Vijayaraghavan v, garg a, wong ch, tai k. Estimation of Mechanical properties of nanomaterials using artificial Intelligence methods. Appl phys a 2013.

[14] Garg a, vijayaraghavan v, wonga ch, tai k. Measurement of Properties of graphene sheets subjected to drilling operation , 2014.

[15] Bernardes, alexandre a., et al. Identification of foliar diseases In cotton crop. In: tavares joao manuel rs, renato natal Jorge, editors. Topics in medical image processing and Computational vision. Lecture notes in computational vision And biomechanics. P. 67–85.

[16] Ghaiwat savita n, arora parul. Detection and classification of Plant leaf diseases using image processing techniques: a Review. Int j recent adv eng technol 2014;2(3):2347–812. Issn (online).

[17] Dhaygude sanjay b, kumbhar nitin p. Agricultural plant leaf Disease detection using image processing. Int j adv res electrElectron instrum eng 2013;2(1).

[18] Mrunalini r badnakhe, deshmukh prashant r. An application Of k-means clustering and artificial intelligence in pattern Recognition for crop diseases. Int conf adv inf technol 2011;20.

[19] Arivazhagan s, newlin shebiah r, ananthi s, vishnu varthini S. Detection of unhealthy region of plant leaves and Classification of plant leaf diseases using texture features.Agric eng int cigr 2013;15(1):211–7.

[20] Kulkarni anand h, ashwin patil rk. Applying image Processing technique to detect plant diseases. Int j mod eng Res 2012;2(5):3661–4.

[21] Naikwadi smita, amoda niket. Advances in image processing For detection of plant diseases. Int j appl innov eng manage 2013;2(11).

[22] Patil sanjay b et al. Leaf disease severity measurement using Image processing. Int j eng technol 2011;3(5):297–301.

[23] Chaudhary piyush et al. Color transform based approach for Disease spot detection on plant leaf. Int comput sci Telecommun 2012;3(6).

[24] Rathod arti n, tanawal bhavesh, shah vatsal. Image Processing techniques for detection of leaf disease. Int j adv Res comput sci softw eng 2013;3(11).

[25] Bashir sabah, sharma navdeep. Remote area plant disease Detection using image processing. Iosr j electron commun Eng 2012;2(6):31–4. Issn: 2278-2834.