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Identification of Pest Using Various Detection and Classification Methods for Smart Agriculture: A Review

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Abstract- The agriculture is the art of science that plays an important role in the livelihood of the people and economy of the country. Agriculture not only produces food grains but also generate employment. In India, the agriculture development is very useful in the process of economic development as it is a backbone of economic system. The agriculture field and farmers livelihood are highly affected due to increase in different types of pest and it affects all types of crops. The different types of pest controlling techniques were applied but still it is a severe problem in the agriculture field. The early detection of pest is the best solution to control the problem of spreading it to adjacent field. This paper presents a literature survey on existing identification of pest using various detection and classification methods. It mainly focuses on pest identification based on pest acoustic signal, pest detection and classification using crop images. The acoustic signal of pest and images are preprocessed to remove the noise content and the enhancement techniques are applied with various existing techniques. The signal and image restoration, enhancement, segmentation, feature extraction and classification algorithms are discussed to control the pest. To contribute future researchers in developing their own algorithm for solving pest problems, a summary of the existing algorithms developed for every stage of algorithm development is also provided. Also, the survey gives the information about the implementation of previous software and hardware based algorithm.

Keywords: Smart Agriculture, Pest detection and classification, Acoustic signal

1. INTRODUCTION

The application of water to the soil for growing crops is termed as irrigation. Irrigation is principally employed in dry areas and in periods of rain shortfalls to extend crop production. Water management to crops is the act of temporal order and regulation of irrigation water applications to meet the water demand of the crop. Management could be a factor within the success of irrigation system. Huge quantities of water, and sometimes labor inputs, needed for irrigation. Irrigated agriculture is one amongst the most important consumer of fresh water with a share up to 80-90% within the developed countries. The water demand is arising due to the shortage of water and environmental changes that the water resources for agriculture are reducing within the forthcoming decades. The correct scheduling of the irrigation can become a significant challenge for irrigated agriculture since up to 50% of the water is wasted in the traditional systems of irrigation. Within the last years, the adoption of sensors for water management in agriculture has received increasing attention with reference to the irrigation optimization and management. The most common sensors offer information regarding the soil quality, such as the soil potential, or the soil water content. Different sensors are used to measure the water quality and properties just like the salinity.

From survey of United Nation Organization (UNO) – Food and Agriculture Organizations, the world wide food production have to be raised by 70% in 2050 to feed the buvgeoing population. It offers massive ample employment opportunities to the individuals. So the crop yield will be improved by involving automatic machineries. There have to implement trendy science and technology within the agriculture for increasing the yield. The advantages of the low-cost, and autonomous sensing and effort devices has significantly exaggerated [1]. The combination of conventional system with latest technologies as Internet of Things (IoT) and Wireless Sensor Networks will cause agricultural modernization. The WSN collects the information from differing kinds of sensors and send it to the

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most server wireless protocol. There are several factors that affect the productivity of crops. It includes attack of insects and pests which might be controlled by spraying the correct insect powder and pesticides and additionally attack of natural animals and birds when the crop grows up. The crop yield is declining due to unpredictable monsoon rainfalls, water inadequacy and improper water usage [2].

Figure 1: Pest affected leaf

Figure 1 shows that the pest affected leaf. The leaf is destroyed highly due to pest. Figure 2 shows that the smart agriculture environment. The WSN network is applied to the agriculture field to get proper information through IoT.

Agricultural yield is lost each year, due to speedy infestation by pests and insects. A lot of research is being conducted worldwide to spot scientific methodologies for early detection/identification of those bio-aggressors.

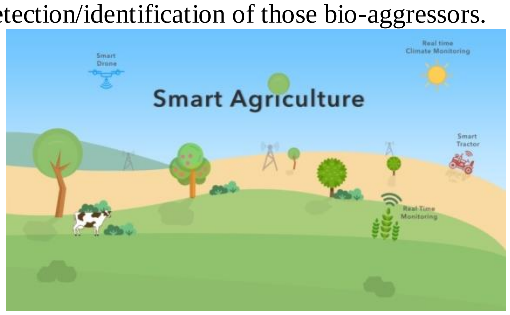

Figure 2: Smart agriculture

In the recent past, many approaches supported with automation and image process have come back to address this issue. The planned methodology involves reduced computational complexness and aims at detection not only in an exceedingly greenhouse atmosphere however conjointly in an farm environment also [3].

The improving technology is used to innovate the agricultural field by using the digital image processing techniques to detect and control the pests effectively with negligible negative impact on the agriculture field. Digital Image Processing approach is a non-destructive testing method that should neither involve the crops or the environment. This paper is organized as literature survey for different image processing techniques like image de-noising, enhancement segmentation, feature extraction and classification.

Vijai Singh and Misra et al., proposed a soft computing technique for detecting the plant leaf disease using image segmentation method. The proposed algorithm will considerably support accurate detection of leaf, and appears to be a necessary approach. In the case of identification of leaf and root diseases, it appears to be a significant method, putting fewer efforts in computation. Disease identification method includes some steps, out of that four main steps are as follows: Image de-noising, enhancement, segmentation and disease detection. For the input RGB image, a color transformation structure is taken, and so employing a specific threshold cost, the green pixels are covert and removed, this is followed by segmentation method, and for obtaining helpful segments the texture statistics are computed. At last, classifier is used for the options that are extracted to classify the disease. The proposed algorithm is implemented by experimental results of 500 plant leaves [6].

Milad Niknejad, Hossein Rabbani et al., address the problem of restoring the degraded images using Multivariate Gaussian Mixture Model (GMM) algorithm [7]. The GMM algorithm is the method for image restoration that is based on the gathering of comparable patches. In the image, the neighborhood is derived from a multivariate Gaussian probability distribution with a particular mean and covariance of the image. There are different GMM models have been applied in various signal and image processing task like audio processing, speech processing, video processing, image restoration and segmentation. Recently, GMM is used to do the image restoration task in sparse and non linear estimation in the image filtering, since the GMM is the hybrid version of linear estimations.

The proposed algorithm is the Piecewise Linear Estimation (PLE) based on GMM that can be applied to image patches. It is similar to Expected Patch Log Likelihood (EPLL), it is a method that is similar to PLE that is small different in the assigning the weight vector and its initialization. However, within the global GMM image restoration techniques, similarity of patches are measured by the Gaussian probability density function part of the patch given the Gaussian parameters assessable within the whole image. However, global GMM strategies fail to completely exploit the coherency of close patches which may be obligatory by constraining the clusters of comparable patches in finite-sized windows.

Taeg Sang Cho, and Lawrence Zitnick et al., presents image restoration based on the method called Matching Gradient Distributions [8]. They introduce an alternate image restoration solution that is capable of reconstructing visually restored textures. The key plan is not to penalize gradients supported a hard and fast gradient previous, however to match the reconstructed image's gradient distribution to the required distribution. That is, we tend to commit to realize image that deception on the several of solutions with the required gradient distribution that maximizes the observation chance. They tend to propose two approaches. The primary penalizes the gradients supported the KL divergence between the empirical and desired distributions. Secondly, this approach might not converge or might realize solutions with gradient distributions that fluctuate considerably from the required distribution. Our second approach overcomes limitations of the primary approach by process an accumulative penalty perform that gently pushes the parameterized empirical distribution toward the required distribution. This results in an image with a gradient distribution that matches that of the required distribution.

Yidan Teng, Ye Zhang and Yushi Chen, et al., are presented structural fusion restoration method using adaptive morphological filtering technique [9]. They propose a hyper-spectral image restoration method creating use of adaptive morphological filtering (AMF) and fusing structure data of associate degree auxiliary color image.

Figure 2. a) Input Image, b) Filtered image using Matching Gradient Distributions method

An adaptive structuring component (ASE) indicating morphological operations of each element is generated through data fusion, to simultaneously take away the mixed noise and preserve fine special structures. This key technology contains 3 main steps. First, edges square measure extracted from the auxiliary image exploiting its color information; second, associate degree edge-constraint growing algorithm is employed to generate the kernel estimation; third, the ASE is obtained through goal-guided k-means clustering.

The ASE has concentrated application value, for it is associate degree enhancing module for many filters-based restoration methods, to moderate the structural damage to the fixed mask. Among these methods, Gaussian filter for preprocessing and majority survey for post-processing measure introduced in this paper as representatives. Additionally, the auxiliary image will be each visible image of multi-sensor and false RGB part of the non-degraded bands of the hyper-spectral image, thus it is comparatively offered. They have investigated and developed a completely unique HIS restoration system which mixes the efficient filtering ways with the adaptive SE (ASE) containing the adaptive morphological details to preserve the spatial structure better. With the extensive application of the hyper-spectral and multisource sensors, structural data becomes easier to get by creating use of the visible image of multi-sensor or RGB element of the bands of the HSI.

Another contribution of this paper is presenting ASE generation methodology with 3 key steps. First, the edges are extracted from the auxiliary image exploiting its color data. From one hand, edges generalize the pure mathematics structure data and describe distribution of high-frequency information; from the other hand, through the specific information are totally different for all HSI bands or multi-sensor images, edges area unit the common data and demonstrate the morphological options of the boundaries. Then, low kernel is created through region growing constraint by the perimeters. Finally, the ASE is generated utilizing the native goal-guided k-means clustering.

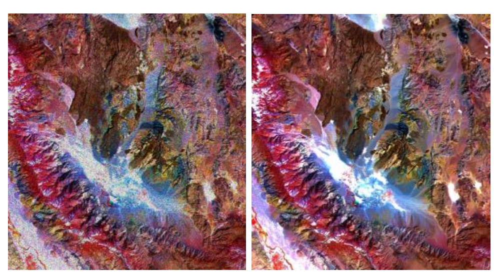

Figure 3. a) Input noisy hyperspectral image, b) restored image using adaptive morphological filtering (AMF)

Limiao Deng and Renshi Yu et al., are proposed pest recognition system with image filtering technique [10]. The automatic recognition of agricultural pests is identified by developing an algorithm based on bio-inspired filtering and LCP (Local Configuration Pattern) algorithm. The crop image are captured using digital camera and it is applied to preprocessing technique to remove different noises from the image. Then a Different of Gaussian (DoG) filter is applied to improve the quality of the image in terms of contrast and brightness. The LCP algorithm is applied to estimate the invariant features of the crop images. The estimated features are given to the SVM classifier to classify the pest on the crop image.

Xueyang Fu and Jiye Wang, Delu Zeng, et al., are proposed image enhancement technique using regularized Histogram equalization with Discrete Cosine Transform (DCT) for improving the quality of the image [11]. An effective image enhancement methodology for remote sensing images is introduced to improve the global contrast and the local details. The proposed system constitutes associate degree empirical approach by histogram equalization (HE) and the Discrete Cosine Transform (DCT) to improve the image quality. First, the global contrast enhancement methodology is introduced by regularizing HE. Specifically, this technique uses the sigmoid function and therefore the histogram to generate a distribution performs for the input low quality image. The distribution function is then used to develop a replacement image with improved global distinction by adopting the quality search table-based HE technique. Second, the DCT coefficients of the previous distinction improved image automatically adjusted to enhance the local details of the image.

A novel and empirical enhancement methodology for remote sensing images is proposed to improve the global contrast and highlight the local information.

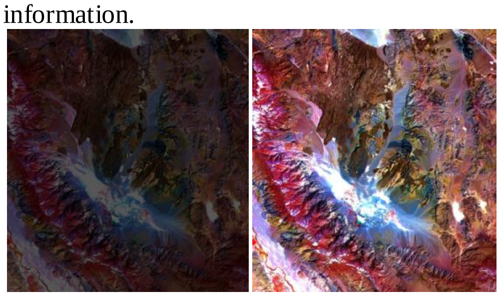

Figure 4. a) Low quality input image. B) Enhanced Image using regularized Histogram equalization with Discrete Cosine Transform (DCT)

First, a new global contrast enhancement methodology which is not the necessity of any parameter choice is given. The new proposed methodology is considered to be improvement of the traditional methodology. A lot of specific algorithm generates a new distribution function to regularize the input histogram by applying the sigmoid function. The proposed algorithm further maps the new generated distribution function to a standardized distribution function. This uniform distribution operate is applied to get the global contrast increased by adopting a regular lookup table-based HE methodology. Second, the DCT coefficients of the previous global contrast increased image by trial and error adjusted with only one parameter to any highlight on the local details. Moreover, a effective thresholding approach is additionally presented with an automatic parameter setting manner. The final output image is obtained by applying the inverse DCT. Since the advantages of each image spatial-domain (histogram) and transform-domain (DCT) are used to improve the image quality in the proposed system, the improved remote sensing image is characterized by high global contrast and local information. Meanwhile, the proposed methodology doesn't introduce saturation artifacts like other image enhancement methods. The qualitative and quantitative analysis was done in the experimental results.

Siddharth Singh Chouhan and Ajay Kaul et al., proposed an automatic approach towards plant pathology [12]. The plant disease affects the normal growth of yield of a crop. These diseases have an effect on complete plant as well as leaf, stem, fruit, root, and flower. Most of the time, once the disease of a plant has not been taken care of, the plant dies or could cause leaves drop, flowers, and fruits drop. Acceptable identification of such diseases is needed for correct identification and treatment of plant diseases. Plant pathology is that the study of plant diseases, their causes, procedures for managing them. But, the present methodology encompasses human involvement for classification and identification of diseases. This procedure is long and easy. Automatic segmentation of diseases from plant leaf image victimization soft computing approach is moderately helpful than the present one. Within the proposed system, they need introduced a technique named as microorganism hunting improvement primarily based radial basis function neural network (BRBFNN) for identification and classification of plant leaf diseases automatically. For generating optimal weight for proposed neural network, they have used bacterial foraging optimization that improves the accuracy of the network to detect and classify the disease affected region on the plant leaf. The region growing algorithm is used to segment the leaf disease area on the image. This work identification and classification of plant disease is performed by exploitation Bacterial foraging optimization primarily based Radial Basis Function Neural Network (BRBFNN). The feature extraction method is done out by seeding associated grouping the points having similarity in some manner utilization region growing approach the training of the RBFNN is performed by bacterial foraging optimization that proves to be an economical and powerful tool for initializing the weight of RBFNN and training the network which will properly determine completely different affected regions on plant leaf image. With the assistance of BFO, the proposed system achieves higher convergence ratio and accuracy.

The figure 5 shows that the leaf disease identification and classification using RBFNN block diagram. In our proposed work, they tend to specialize in identification and classification of plant diseases using some computational intelligence approach. The proposed methodology uses Radial Basis perform Neural Network (RBFNN) that is trained with the assistance of BFO, to search out the affected region through completely different diseases on plant leaves.

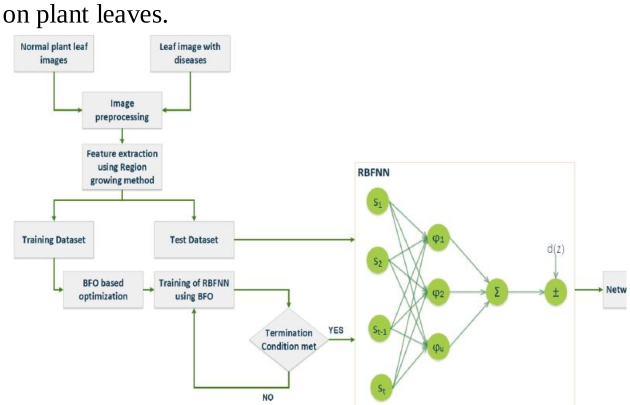

Figure 5. Leaf disease identification and classification using RBFNN

RBFNN is that the special linear functional network having a unique competency of that will increase or decreases monotonically with distance from the middle purpose capable of handling the complexness of the affected region exists on the plant leaf images. The potency of the RBFNN is more increased by region growing methodology searching for seed points and clustering them having similar attributes that facilitate in feature extraction method. BFO with its mimicking capability and multi-optimal function verities to be an efficient and powerful tool for initializing the load of RBFNN and training the network that may properly determine completely different regions on plant leaf image with high convergence speed and accuracy.

Trupti and Bodhe et al., is presented image segmentation process based on the color space selection to detect the pest on the crop [13]. The proposed work suggests Entropy based thresholding during which the most information content is decided to come to a decision the segmentation rule. Results are dependent upon a color space selection. The suggested segmentation algorithm is applied for image of infected leaves. Color image segmentation using the entropy based thresholding which is based on the 'information content' measured by entropy that is employed to pick out the color area domain.

Ramakrishnan and Sahaya Anselin Nisha et al. is proposed back propagation algorithm for groundnut leaf disease identification and classification [14]. The plant disease completely destroys the quality of the leaf. The Groundnut disease Cercospora is one of the disease that affects the early stage of ground nut leaf. The upgraded process pattern contains different leading steps. At the start a color renovation represent intended for the input RGB image is created, this RGB is converted into HSV as a result of RGB is for color descriptor and color generation. The succeeding process is the plane separation and next process is the color features estimation. Then back propagation algorithm detection of plant disease is successfully completed. In the proposed system, the preprocessing technique is applied to restore the image and enhance the image quality. The segmentation method based on Otsu's method and statistical analysis technique and co-occurrence matrix is calculated for feature extraction. Finally the neural network is applied to classify the given image to identify the pest affected plantation. The given method RGB image is converted to HIS color space then the color image is estimated from GLCM matrix, then the texture feature extraction is estimated using 32x32 patches.

Marion Neumann and Lisa Hallau et al., is presented plant disease segmentation and classification for cell phone images using erosion band features [15]. They introduced a completely unique set of options for a difficult image analysis task in agriculture, wherever mobile phone camera images of beet leaves analyzed on the presence of plant diseases. Aiming at nominal automatic process on the cell phone image and extremely correct prediction results, we have a tendency to give efficient detection of disease regions on the image and classification method supported texture options. They have applied many first- and second-order feature extraction methods for classifying textures of leaf and that notice that a mixture of descriptors derived on multiple erosion bands of the RGB color channels, as well as, the local binary patterns (LBP) of gradient magnitudes of the extracted regions accurately distinguish between symptoms caused by 5 diseases, together with infections of the fungi Cercospora beticola, Ramularia beticola, Uromyces betae, Phoma betae, and the bacterium Pseudomonas syringae.

Hossein Zamanian and Hossein Pourghassem et al., is presented pest detection based on bioacoustic signal using spectral and temporal feature extraction of the signal [16]. Insect identification may be a primary requirement of entomologists for analysis applications and pest management. Cicadas are the problematic pest that destroys the plant. The species-specific acoustic of cicadas play a significant role within the pest recognition. Acoustic characteristic is beneficial within the identification of cicadas, notably once alternative characters are unavailable because of capture issues of cicadas. Five species of cicadas are measured by their bio-acoustic sounds.

The acoustic signal of every Cicada has been characterized by twenty-nine options in each spectral and temporal domain. To optimize the identification, the genetic algorithm and outlier omitting methodology are used and therefore the best options of identification of pest introduced to multi-layer perception classifier. The results of insect identification algorithm show proposed algorithm with the accuracy rate 99.13%.

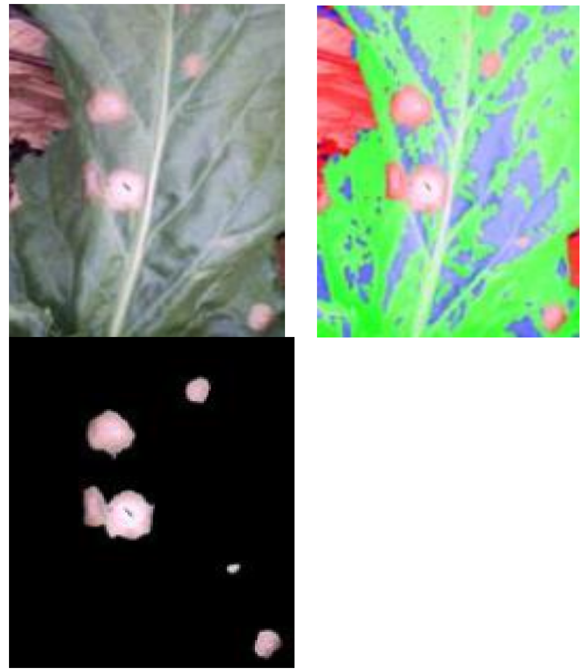

Figure 6. a) Cell phone input image, b) color filtered image, c) Segmented image

2. CONCLUSION

The proper controlling method of pest is most important criteria to realize the profit in Agricultures. The pest identification and classification process is established with different level of achievement for agricultural field. The acoustic signal processing and image processing both are playing important roles in pest control domain. The filtering of noise and improvement of quality of the signal and image are mandatory in segmentation process. The segmentation task is used to detect the pest on the plant. The feature extraction is used to calculate the features to apply the neural network. The neural network is applied to classify the pest based on the signal and image.

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