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Detection and Diagnosis of Plant Pests Pistachio Tree in the Section "Fruits and shoot", using by Color Properties and Texture

Hassan Pahlovariy
Faculty of Electrical and Computer Engineering
Semnan University
Semnan, Iran
H.pahlovariy@gmail.com

Farzin Yaghmaee
Faculty of Electrical and Computer Engineering
Semnan University
Semnan, Iran
f_yaghmaee@semnan.ac.ir

***Abstract*— The use of image processing techniques are is growing. Many research and studies in the field of medicine, robotics, meteorology and military have been done and it gets a lot of use. But research on the use of image processing methods in the diagnosis of plant pests, less discussed and investigated. It is in this paper attempts to identify more plant pests of pistachio trees using image processing techniques to do your research. By doing this pest diagnosis and plant diseases in parts of the pistachio tree fruits and shoot by machine is an intelligent manner. It can be said with more general view of the tree pest diagnosis expert system with a database of a database of healthy and infested plant photos in the fruit and shoot by CCTV cameras, farmers, or even unfamiliar people in assessing image been collected, After sending the Machine backup, by methods of Image color detection, Type of pest is detected and compared by Machine. This requires constant monitoring are experts in traditional mode, which is expensive in large farms, in some developing countries, agricultural engineers may be limited mileage and connect with experts pest detection. Important goal of this method early diagnosis pest of pistachio trees and reducing the rate of error in diagnosis and given to farmers and as a result of quality harvest for exported.**

Keywords*— *Diagnosis of plant pests, Image processing techniques, Color Image, learning machines, complexity of the model.

I. Introduction

Today, for visual identification of plants, expensive, inefficient, difficult, and sometimes undetected and the need for specialized and trained pest expert [1]. Considering to the absence of previous methods for diagnosing pest of pistachio trees, Intelligent image processing methods and proposed procedure in this paper Using color-changing properties of the fruit and shoot pistachio tree and extract suitable features, This change of color texture and a series of mathematical operators use the Classification, In pistachio orchards, pesticides parts of stems and fruit, The percentage of correctly fit Been diagnosed.

Given the number of features used in this work (a total of 46 features), the reduction of features has not been used [2]. The proposed approach is general steps are as follows: First stage: pre-processing to focus on color or highlight color channels and integration of lighting tissue. second stage: The process involves several stages :In multi-level wavelet transform is applied, Energy gradient operator applied to the output of wavelet and gradient feature extraction of wavelet images and directly from the images wavelet , and using the extracted feature set at an appropriate classification to maximize the percentage of correctly, and Validation of results.

II. Intro Database

Since there is no standard database that requirements of all the proposed methods of image processing is to standardize comparisons, one of the challenges facing these types of articles. A perfect database and the integrity necessary for pests stems and fruits of pistachio tree was created and Categories, to do this in cooperation with pistachio growers in Semnan province.

At a suitable time interval of approximately 4 months, between the creation of the pistachio and it is harvest time, a total of 18 garden of pistachio orchards 450 photos were taken in 12 different categories. In different categories in an excel file folders modeling to ultimately be the collection of photos and files excel proposed method can be used for training and testing algorithms.

III. Preparing Database

Given that all learning algorithms need to be specified instead of pesticides for pest detection. By designing a special program of all captured images, including pictures of the gardens are pests with a sufficient number, Windows related to the pests And the number of corresponding parts of a pest window And healthy image was found and X and Y corresponding to each window in a MATLAB file was stored as a variable cell.

Given that the number of pests in various different image [2], Select cell variable is the perfect choice, because it is unable to accept the size and number of different variables. This database is stored in JPG extension. And for each folder Disease a MATLAB file attached the pesticide information and healthy place for training algorithm, which has been tailored to different images. Here are some examples of different images for the database and how it has been designed.

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Figure 1 -displays insect bites wasp

Figure 2 displays wasp brain-eating pest

Figure 3 displays the pest oyster shell scale

Figure 4 displays the mealy bug pest mite

The first step is to choose a place infested with convenient window that all the x and y infested areas corresponding to all the pictures are stored. Below are a sample of the selected areas.

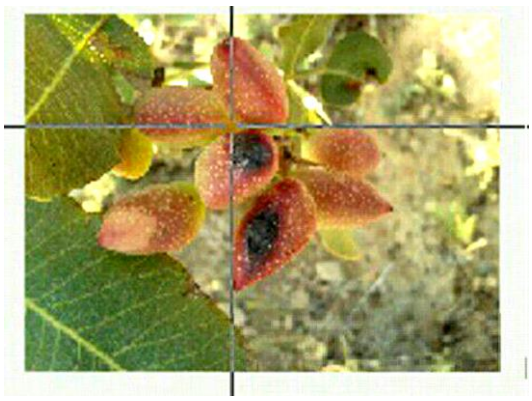

Figure 5 displays the location of the pest by appropriate window

Second step: according to the above form and selection of a pest, all points on the x and y specify and save it. For example, in Figure 4 points according to the following table, each point has two parts (zone start and finish area selected). (Only the first row below).

Table 1: marked points pertaining to the pest in terms of x and y

Row	The name of the region in terms of (x, y)	District election (X)	Area ending(Y)
1	Mstsyl selection of 4	325.25 406.25	196.25 265.25

The third step: do this for the healthy and the table we save them. Step Four: The selected points in the previous step, in this part of the area damaged by the computer fruits are visible stained and broken down completely.

Figure 6: View images Pest on the left, determine the location of the pest in the right image

IV. Preprocessing

Due to the different quality of photos taken, Inconsistency can lead to reduced quality of the proposed approach. To unify the image quality all the same quality images of 800 x 600 and also with the same intensity histogram of the entire range of brightness from 0 to 255 all photos are assigned to. Given that the all of the algorithms used and attributes directly or indirectly related to image and color intensity in different channels corresponding functions are, so to raise the percentage of correctly similar analysis the requirement that the whole be the same histogram distribution. By obtaining this transfer coefficient linear equation corresponding angle, All numbers between 0 and 255 pixels of image data mapping and finally answer the 8-bit space is properly stored. To show the importance of standardization of the histogram, forms, 7 and 8, a sample image from the images in the database, along with its histogram is shown before and after synchronization.

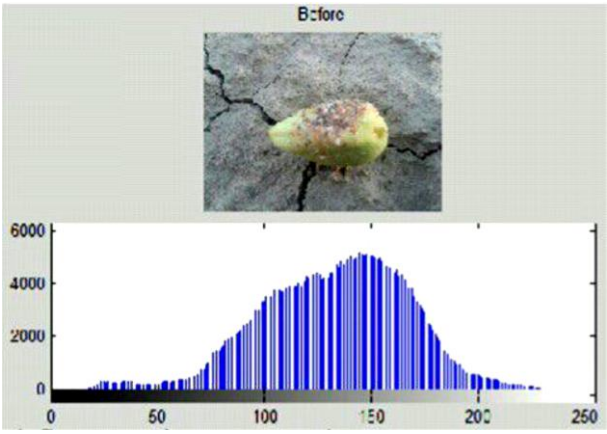

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Figure 7: The image histogram of the sample database with synchronize

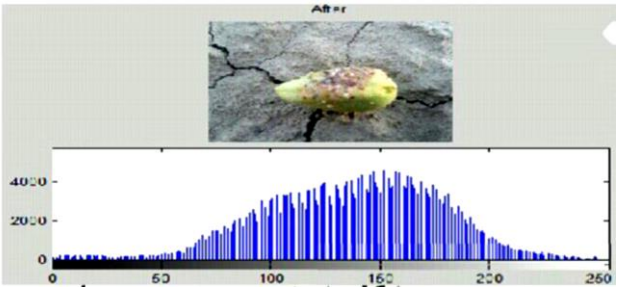

Figure 8: Image sample database, along with its histogram after synchronize

As can be seen in Figure 9 Pests and diseases stalk the one selected in the filtered image First, the operator RGB2GRA entire color space is applied to the gray area And the image is displayed all channels in the original image. The three images are then color separation three channels. As is clear that none of the channels alone, more details of pests to other tissues in your image does not show. According to the color and nature of the pest shoot, it is in this stage the entire color space used and using pesticides color difference with the stems in the later stages feature extraction and separation is necessary.

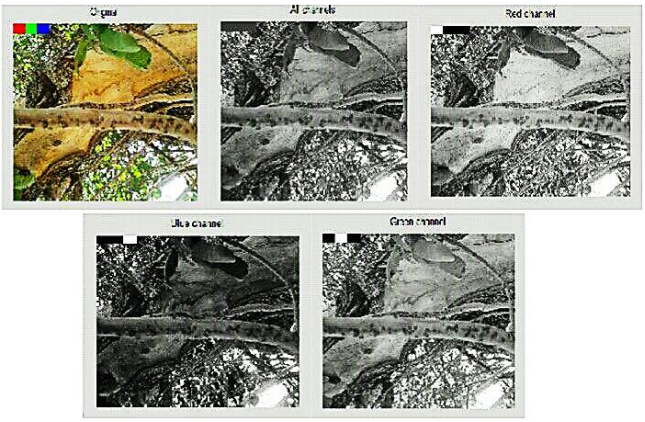

Figure 9: Main images of the stem with images after the filtering

V. Feature Extraction

The most important part of all recognition algorithms, the feature extraction stage. If the selected features, features not correct, surely the desired result is not achieved in the classifieds. Proposed procedure, the various levels of information using wavelet transform image Channels, horizontal, vertical, diagonal and approximate were and then using the 5 conventional operator statistics based on different parts of the image window, the statistical features are extracted. After extracting the features (a total of 46 features) using a suitable mapping, the features are more limited and then to input various algorithms classification will be applied.

VI. Wavelet

Wavelet transform is a great alternative to the Fourier transform, or transformations based on the frequency characteristics of fixed-time work. Points out wavelet transform in frequency bands up and down details of the picture And the ability to set a different frequency range in which the different parts of the differences in color and image frequency In fields with fruit drop and parts can normally shoot with wavelet transform, to a right turn, turned to specify parts of the pest [3]. To demonstrate the importance and influence of the mother wavelet function for a sample image, the output of two-dimensional wavelet algorithm and 8symlets in forms 10 and 11 are haar to haar feature extraction algorithm further details to be shown.

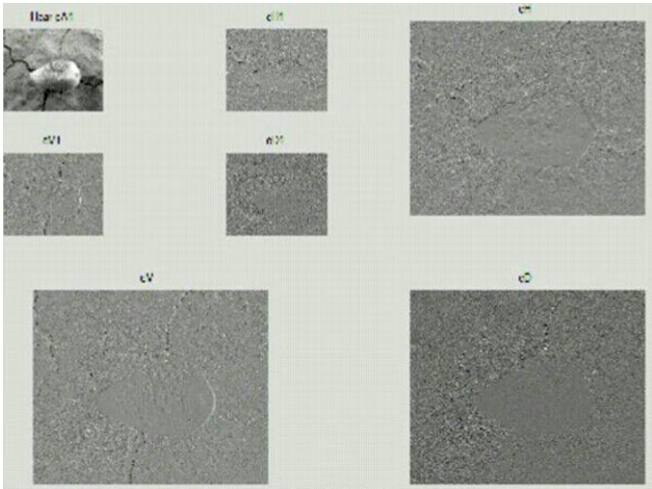

Figure 1 0: output in 4 channel Haar wavelet with our function-vertical-horizontal-diagonal approximately at the level of 1, 2

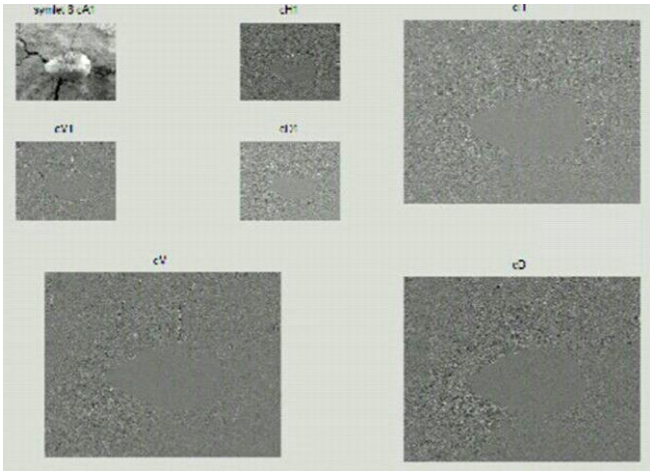

Figure 11: The output in 4 channels 8 Simple mother wavelet function almost-vertical-horizontal-diagonal in 1, 2

Finally, through these functions, based on visual observations performed the best results in terms of accuracy and resolution wavelet algorithm haar respectively. Given that Haar wavelet algorithm in image output was better answer, we chose it as appropriate algorithm. If Haar wavelet at different levels in the vertical and horizontal channels (ch & c) be careful Pests are quite clear, whereas no such distinction is not clear exit of the wavelet Symlets8 and only someone who has seen the original image is able to detect lesions and normal tissue in these images of each other. The output of the third and fourth level to the next, haar wavelet algorithm does not in itself any useful information channels. In Figure12note, in addition to window size 48 x 48 dimensions output in the third level and above is very small and thus the output of the third level wavelet transform for feature extraction does not have sufficient efficiency.

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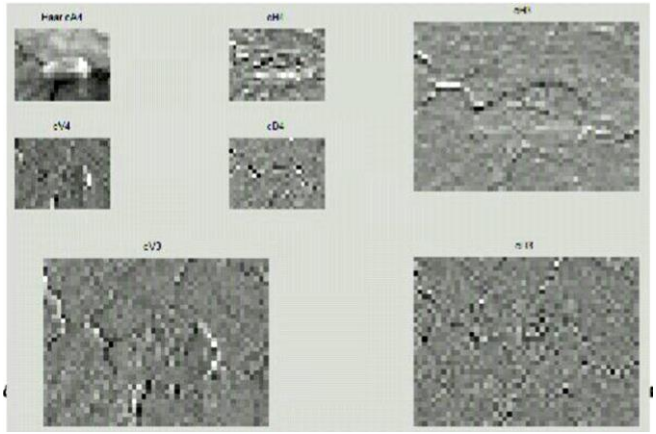

Figure 12: The third and fourth level information displays a sample image using wavelet transform algorithm haar

VII. Energy Gradient Operator to Sharpen the Accuracy of the Algorithm

Despite it being infested implicit in the image, the image of the tissue is relatively uniform And even if the eye is not known pest location, Separating it from the fruit, stems or surroundings will not be an easy task Due to the fact that the accuracy of the algorithm could close due to the characteristics in different regions to reduce, It was necessary to use operator that highlights the differences and differentiation location specified in the wavelet transform with conventional tissue that color fruits and shoot them with pesticides difference was certainly better show. The most tangible operator that can be used in these cases, a national operator of energy. Gradient operator has fruit with acceptable accuracy margin streaks on the ground and determine the infested fruit uniform in texture.

VIII. Energy Gradient Operator to Sharpen the Accuracy of the Algorithm

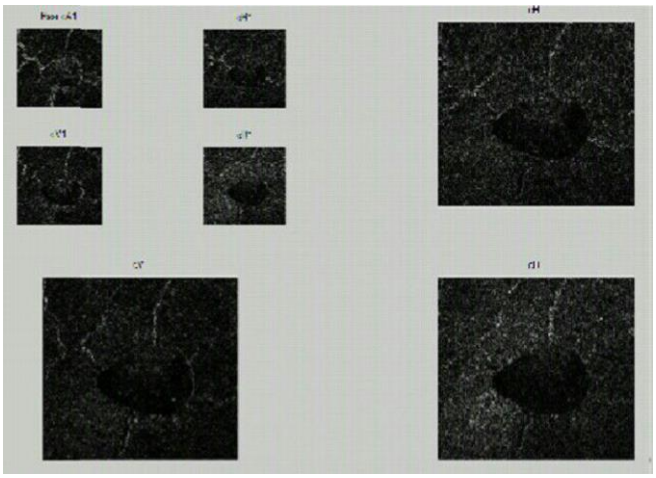

Figure 12: Displaying data in 4-channel energy gradient approximation-vertical-horizontal-diagonal in 1,2

Gradient operator could accurately suggests an acceptable margin of fruits streaks on the ground and in the context of the infested specify a fruit.

IX. Statistical Feature Extraction

After applying wavelet transform to the image input and output extracted wavelet at different levels depending on the size pest that has already been identified in a database, wavelet set of outputs that we are different in size dimensions. In the case of normal tissue because the tissue was better than the pistachio as well as the background image, when creating a database of images of infected tissue, healthy tissue was selected to be the same two classes. The database also contains examples infected extracted both healthy tissues. According to the above description and that of course will not be the same image size, there is the possibility of direct use of the images database as details because the size of the images and features with different aspects of the classification is not acceptable, And so to be able independently of the size of the input image extracted features If desired output images after m * m is wavelet have any features at all levels can be used to extract entropy formula, the energy of average, variance and orientation of clusters could be used. [4] Formulas (1) and (2) respectively, pre presents the sum of the probability of a window M × N and the absolute possibility, to create input and extraction features five based on texture and color is used.

$$p_{x+y}(k)=\sum_{\substack{i=1\\ i+j=k}}^{M}\sum_{j=1}^{N}p(i,j) \qquad k=2,3,\ldots,M+N \tag{1}$$

$$\mu=\sum_{i=1}^{M}\sum_{j=1}^{N}\left|p(i,j)\right| \tag{2}$$

Table 2: Formula properties were obtained [4]

Formular	Descriptor
$f_1=\sum_{i=1}^{M}\sum_{j=1}^{N}p(i,j)\log(p(i,j))$	entropy
$f_2=\sum_{i=1}^{M}\sum_{j=1}^{N}\left[p(i,j)\right]^2$	Energy
$f_3=\sum_{k=1}^{M+N}kp_{x+y}(k)$	Total Average
$f_4=\sum_{k=1}^{M+N}(k-f_3)^2p_{x+y}(k)$	Total variance
$f_5=\sum_{i=1}^{M}\sum_{j=1}^{N}(i+j-2\mu)^2p(i,j)$	Cluster trends

The following simple operators to energy and variance of pixels in a window is used to determine normal tissue from infected tissue, by extracting the statistical parameters of the image gradient and Given that the we had a total of three output image gradient 6 features will be added to the features related to wavelet. The proposed algorithm will be a

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total of 46 features, 40 of them directly from the output of the extracted wavelet function and 6 features are indirectly dependent on the output wavelet function the gradient operator is applied after it has been extracted.

X. How to Create Training and Testing Information

To determine the value of the extracted features in Table 3 a sample of every feature provided with the calculated value the reader is familiar with the numerical properties. Due to the large number of features of each sample are shown only a model.

Table 3. The numerical value of the characteristics of a healthy and infected leaf tissue

Feature name	The infected tissue specificity	The characteristics of healthy tissue	Minimum amount	maximum amount
Total gradient horizontal channels wavelet Level 1	1286.368	157.5837	2.495298	16571.47
Variance gradient horizontal channel wavelet Level 1	36.37206	20.37795	3.305974	105.4152
Total vertical channel gradient wavelet Level 1	486.4228	106.5799	0	23669.2
Vertical channel gradient variance wavelet Level 1	24.6935	16.56301	0	153.7759

XI. Mapping Features

According to the numbers presented in Table 3, Table 2 formulas output values are too large. When algebra algorithms usually due to rounding error produced Classifieds paragraph and paragraph affects the performance and the percentage of correctly classified. Usually normalization method, between zero and one is used to avoid this issue. In this way all the features according to the maximum and the minimum value in a range between zero and one are. Finally, with the highest percent correct mapping elected the mapping was used. As some features columns about the maximum and minimum range of positive and negative values and their changes is very high. Therefore they need to map a function that accepts both positive and negative range at this stage, therefore, we first used a third of the root. It is normal in this case if, for example, have 10^18 features, taking the cube root of its value becomes the number 1 0 ^ 6. To show the normal amount of features for the mapping mode, In Table 4 are limited to values in the table show them completely.

Table 4: The amount of features for the mapping mode for a healthy and infected leaf tissue sample

Feature name	infected tissue specificity	characteristics of healthy tissue	Minimum amount	maximum amount
Total gradient horizontal channels wavelet Level 1	1.281	1.134	0.98	1.53
Variance gradient horizontal channel wavelet Level 1	1.062	1.040	0.99	1.11
Total vertical channel gradient wavelet Level 1	1.207	1.113	0.92	1.57
Vertical channel gradient variance wavelet Level 1	1.047	1.032	0.92	1.13
The total gradient diagonal channel wavelet Level 1	1.076	1.023	0.92	1.29
wavelet diagonal channel gradient variance level 1	1.012	1.001	0.92	1.08

XII. How to Create Training and Testing Information

After extracting features from the image it is necessary to separate the infected fruit to nuts, from healthy fruits or stems has a loss of normal stem, After extracting features from the image it is necessary to separate the infected fruit to nuts, from healthy fruits or stems has a loss of normal stem, Properties in our Classifieds Section according to them, could do this separation. The project consists of three categories of classification: svm, neural networks and categories used Boostin finally, by analyzing the performance of these three groups, appropriately chosen Classifieds section and with different criteria than other classes of dams has shown its capabilities.

A. Using SVM Classifieds Section

According to the training and testing, with a ratio of 30 to 70 , in different performance tests were conducted 10 times and ultimately implement best extraction rate of between 10 times and in the table given below. Best answer correctly in terms of the difference is too high, compared to other core kernel is RBF [5] although the percentage of RBF kernel in terms of training and testing is a relatively large difference is not desirable.

Table 5: Data teaching and testing algorithms

Kid of algorithm	Percent data integrity training	Percent data integrity testing
Linear	86.3	82.6
Quadratic	--	--
Polynomial	--	--
MLP	58.4	56.6
RBF	94	85.2

B. Using Neural Network Classifieds Section

Neural Network of Classifieds clauses very common and widely used in various fields that such privileges than the Classifieds Section svm, it is applicable to large classes without having to modify the structure or core and learning algorithms [6].Due to high parameters of neural networks to choose from, in this project we've tried variations on neural networks, in the first simulation network types and number of layers between those variables was assumed that the results are given in Table 6.

Table 6: training and testing data in the algorithm

Kid of Algorithm	The number of middle layer	Percent data integrity training	Percent data integrity testing
Feed forward net	5	88	83
Feed forward net	10	87.9	86
Pattern net	10	60	59
Fit net	10	87.9	86.7
Cascade forward net	10	88.5	85

C. Boosting the Classifieds Section

There is also a wide variety of classes Boostin Section. This type of provision is a logical math classes use probability to make decisions in terms of performance techniques such as neural networks are quite different and their specific nature

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[7]. Boostig to 10 times more common in 5 different categories, implementation, testing ultimately the best answer based on the percentage of the total is given properly.

Table 7: training and testing data in the algorithm

Kind of Algorithm	Percent data integrity training	Percent data integrity testing
AdaBoostM1	86.2	83.6
LogitBoos	89.4	85.2
GentleBoos	94.7	85.7
RobustBoos	89	85.2
LPBoost	100	78

Adaboost m1 method, Core LogitBoost, GentleBoo, LPBoost ،RobustBoos, that among these 5 methods, LogitBoost and GentleBoost relatively better performance than other methods shows. It should be noted, however, distance training and testing in GentleBoos that a relatively large number as a parameter is negative we present an algorithm that is suitable and in terms of training and testing both relatively at the correct distance from one another, higher.

XIII. Choosing the Best Use of Specificity and Sensitivity Classifieds Section

Due to the proximity of the percentages obtained and sometimes variable distance between the percentage obtained in the training and testing, one of the common methods used to select the appropriate Section of the feature classes specificit and sensitivit means of specificity and sensitivity [7] on this basis according to the number of healthy pest has been detected and the number of healthy samples have been diagnosed pest sensitivit two criteria are defined and specifici the selection criteria is the preferred algorithm horizon where the probability of losing pests and identify it as less healthy tissue. As in the case of contaminated pistachios or a healthy fruit for pest detection in human control and it would not rule out significant harm is done. But if the algorithm operates in the field of making the wrong decision and a sample of healthy pest predict it is possible that the load is not controlled, According to detecting healthy, very substantially in terms of cost or spraying losses will follow. So in the selection process Classifieds Section, the better it will be seen that each group select one of two that have better percentages finally, based on these two criteria, namely specificiti and sensitiviti decide which classes Section of the proposed method is more appropriate. In the graph shown in Figure 13.

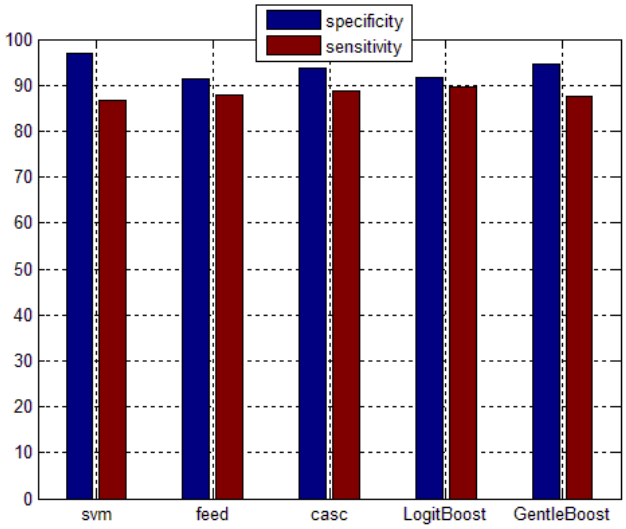

Figure 13: Shape of the sensitivity and specificity

As the figure shows, despite percent less specificity procedure of LogitBoos, because of the symmetry between sensitivity and specificity or closer of the two values together and a higher percentage than other categories LogitBoost procedure eventually chosen as the Classifieds Section Classifieds appropriate section proposed procedure, boosting methods were LogitBoost core.

XIV. Validate (properly verified)

Because all based learning methods such as neural networks, SVM and AdaBoos other methods when they learn of a random process used in the test and train it is necessary that the different methods used to test and train the random nature of credit obtained as a result of not foggy. The most common approach in the field of k-foldcrossvalidation is due to extensive use in the Articles Today, we have used 10-foldcrossvalidation [7]. The algorithm is divided into k equal parts so (k-1) for training and a section of the algorithm used for testing and evaluation. Training System repeats the process k, and finally, if the answer in most cases, the assumptions were correct, trained and have the system function properly. In fact, the results of the test percent, the buffer, shuffle mode that is completely unnecessary.

Table 5: Percentage of data integrity in categories

Kind of Algorithm	Percent data integrity training	Percent data integrity testing
1	88.35	89.87
2	88.49	86.60
3	88.33	90.0
4	88.77	86.07
5	88.49	88.60
6	88.35	89.87
7	88.21	91.13
8	88.76	86.25
9	88.92	84.81
10	88.35	89.87

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XV. CONCLUSION

In this paper aims to diagnosis, fruits and shoot pistachio trees image processing techniques have been. After compiling a database using a program designed in MATLAB, images of the same size and pests labeling parts of the human face, was used in the labeling of rectangular windows, the x and y coordinates as the specified pest and pest space is defined in the database. After various stages of feature extraction using wavelet function in combination with energy gradient was chosen as the best indicator in a variety of pests by identifying these two operators as the operators selected, mother wavelet function and the appropriate levels it was created, So that its computational load to the minimum and the maximum resolution is proposed. Finally, Because of the very top features and their changes a suitable non-linear mapping features to deliver value to the range of input Classifieds Section was appropriate. Of the three main methods of classification neural network, support vector machine-based and statistical methods Boostin tested, finally, Section 5 class rather than the above-mentioned three groups analyzed using two measures of sensitivity and specificity were complete that among all classes of the bed, Classifieds Section logitboost Boosting core algorithm was selected as the best class Section with the highest percentage correctly. Of the three main methods of classification neural network, support vector machine-based and statistical methods Boostin tested, finally, Section 5 class rather than the above-mentioned three groups analyzed using two measures of sensitivity and specificity were complete that among all of the Classifieds Sections, Boosting Classifieds Section with logitboost core algorithm was selected as the best to Classifieds Section with the highest percentage correctly.

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