International Journal of Natural and Engineering Sciences 9 (3): 45-53, 2015
ISSN: 1307-1149, E-ISSN: 2146-0086, www.nobel.gen.tr

Identification of Mango Leaves by Using Artificial Intelligence

Imran MAQBOOL[1] Salman QADRI[1*] Dost Muhammad KHAN[1] Muhammad FAHAD[1]
[1]Department of Computer Science & IT, The Islamia University of Bahawalpur, Pakistan

*Corresponding author:
Email: salman.qadri@iub.edu.pk

Received: September 09, 2015
Accepted: October 13, 2015

Abstract

This research presents a classification based novel artificial intelligence approach of Mango Leaves recognition. The design and implementation of an artificial neural network system that extracts specific shape and morphological features from mango plant leaves of three kinds is presented in this research. Modules of significant mango leaf image features are identified using a novel feature selection technique. This technique reduces the dimensionality of the feature space leading to a simplified classification and identification scheme appropriate for real time classification systems for better results. In making the system complete, a full account is given of the necessary image processing methods that are applied to the binary images of mango plant leaves to ensure identification. These methods include the extraction of shapes from binary images.

The proposed method inherits size and orientation invariance with respect to the image datasets and it can operate successfully even with leaves samples that are deformed due to dropout or due a number of holes drilled in them. A considerably very high classification ratio of 96% to 98% was achieved, even for the identification of deformed leaves.

Keywords: Mango Leaf, Morphological Feature**,** classification, artificial neural network (ANN), CVIPTools

INTRODUCTION

Pakistan is an agriculture based country. Its economy is solely dependent on agriculture. The food inflation is a national challenge. Scientists, agriculturists work day and night to promote the yield of food grains. It is very difficult to infer the varieties of a plant species by simple visual observation. It is very time consuming and can be accomplished by the trained botanists.

In this work I have tried to identify the varieties of mango leaves. Mango (Mangifera indica L.) is considered as the king of fruits due to its nutritional value and taste. Mango trees have a large no. of varieties. Three different varieties of mango plant (Anwar Ratol, Chaunsa and Maalda) have been taken as our frame of reference and investigation.

Detecting digital image become the most important system applications for industrial use to facilitate the user and to save time. These methods has been developed years before but improvement of it is still require necessary in order to obtain the target in efficient and accurately way. The goal of this research is to detect and classify the leaf image (using mango Leaves of different varieties) using some method such as image processing and shape detection.

The CVIPTools program should automatically detect the features and classify the digital and segmented image from features. This research contains two branches machine vision in addition to machine classification. A machine vision branch used image processing anywhere the features like size, color histogram and gray histogram are mined. The parameters are given for classification that describes artificial neural networks ANN for identification of mango leaves of different verities.

Background

Many methodologies have been proposed to analyze plant leaves in an automated fashion. A large percentage of such works utilize shape recognition techniques to model and represent the contour shapes of leaves, however additionally, Binary and RST-Invariant features of leaves have also been taken into consideration to improve recognition accuracies. Lakshmi Dutta and Tapan Kumar Basu 2013 [1], proposed a method to identify variety of mango tree on the basis of geometrical and morphological features of its leaves. P.R.Eddy et al 2006 [2], presented two image classification techniques Neural Network and Maximum Likelihood Comparison (MLC) are compared for accuracy in corps species discrimination. Li Chen et al 2010 [3], proposed a method of weed identification by using a technique of Image Processing and Probabilistic Neural Network (PNN). Christopher and Korah have used vision based texture cues for desert road following [21]. Another interesting system developed by Ollis and Stentz [22] navigated an industrial alfalfa harvester by following the cut/uncut crop line in a field. To do this, a color image was taken of a field, and a best fit step function was computed for each image scan line using the Fisher linear discriminant in RGB space. More information on appearance based related work can be found in [23].

Image Preprocessing

Plants are basically identified according to their morphological and geometrical features of their leaves .These features of leaves are captured with the data acquisition system e.g. digital scanner or a digital camera. The acquired image is processed by digital image processing technique explained in Section III. Brief accounts of the two significant leaf features are detailed below. Geometrical and Morphological Features: The geometrical features are associated with the shape of the leaves such as length, width, aspect ratio and so on.

Fig.1. (a) Colored Image of "Anwar Ratol" mango leaves, (b) Edge detected output of the "Anwar Ratol" mango leaves

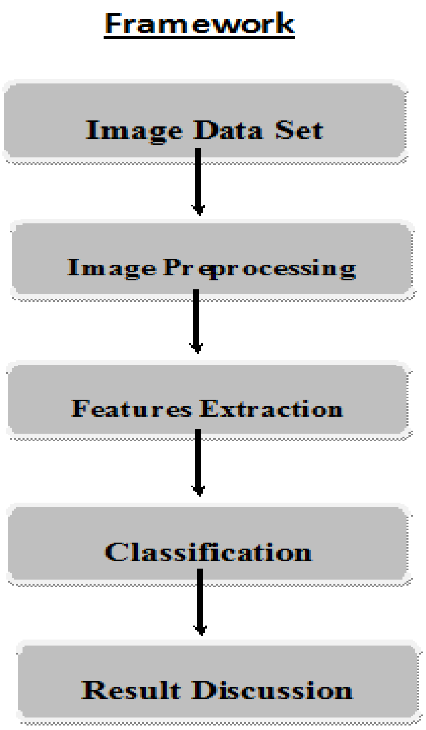
Edge Detection

The method as well as edge detection differentiation is the function gets all the required input parameters, as a substitute of standard input.

$G[f(x,y)]=[f(x,y)-f(x+1,y)]^2+[f(x,y)-f(x,y+1)]^2\}^{1/2})$

$G[f(x,y)]=|f(x,y)-f(x+1,y+1)|+|f(x+1,y)-f(x,y+1)|$

PROPOSED METHODOLOGY



This part of research has the different stages as well as methods discussed in this section in which separated and identification of the Mango trees on the basis of following methodology.

Primary footsteps in Image Processing

Basic stages in image processing were image capturing or gaining, preprocessing, segmentation, image illustration, explanation, and recognition. Explanation of above steps is given below briefly.

Image Capturing and Image Data Set

Images of Mango leaves of three verities Anwar Ratol, Chaunsa and Maalda were taken from an 8 mega pixel digital camera, keeping the distance of two feet in between mango leaf with white background. Each mango leaf image is captured from peak sight of white surroundings.

Image Preprocessing

When the digital image is taken, then the coming stage is preprocessing. A basic method of preprocessing is to get better the image to obtain improved outcome for the other images. This basically covenant with methods for removing unwanted noise, attractive contrast of image as well as separating sections of binary image. These were three major kinds of image preprocessing that are image compression, binary image enhancement and image measurement.

Features Extraction

Binary Features

Length

The length of the leaf is the distance between the points on the same leaf.

Width

The maximum horizontal distance between the two points laying on the edge of the leaf is considered as the width, W of the leaf.

Aspect ratio

Described as the proportion of length in the direction of width of the leaf. Length/Width is known as aspect ratio.

Area

The area of the mango leaf is found by counting the no of pixels of binary value 1 on smoothed mango leave image and denoted by A.

Perimeter

The perimeter of binary images of mango leaves is defined by calculating the total no. of pixels present on the leaf image.

Form factor

This feature defines the relation between a leaf and a circle. It is defined as $FF=4\pi A/P^2$, where A is the area of the mango leaf with P is its perimeter

Euler number

It describes the difference between the number of parts of image $E = S - N$

Projections

Projections needs values for height and width of a normalizing box. The object of interest will be resized to fit against the upper and left sides of the normalizing box before the projections are calculated. For Projection the entire normalized length and width are 10. Projections need values for height and width of a normalizing box. The object of interest will be resized to fit against the upper and left sides of the normalizing box before the projections are calculated.

Thinness

This function calculates the leaf image thinness ratio of mango plant. Ratio is described

Thinness ratio = 4*pi*area / (perimeter^2)

Where area is area of the binary image, and perimeter is the length of outer edge of the leaf image. The irregularity is opposite of thinness.

Centroid

Convert the centroid to integer to get the row and column.

centroidColumn = int32(centroid(1)); % "X" value

centroidRow = int32(centroid(2)); "Y" value.

Then extract a row or column and use find to find the first and last element that's set:

Orientation

Orientation is used to find the axis of least second moment of mango leaf image of interest on a labeled image. The origin of image is the center of area of that leaf and the angle measured from the r-axis counter clockwise. Equation is given by

$$\tan(2\theta)=\frac{2\sum_{r=0}^{N-1}\sum_{c=0}^{N-1} rcIi(r,c)}{\sum_{r=0}^{N-1}\sum_{c=0}^{N-1} r^2 Ii(r,c)-\sum_{r=0}^{N-1}\sum_{c=0}^{N-1} c^2 Ii(r,c)}$$

Binary Features of Anwar Ratol (Train Set)

Name	Row	Column	Area	Centroid_ Row	Centroid_ Col	Orientation	Perimeter	Euler Number	Thinness	Aspect Ratio
1.jpg	102	666	1	102	666	0	1	1	12.566371	1
2.jpg	272	769	6	273	768	-37	6	1	2.094395	1
3.jpg	238	860	2	238	859	90	2	1	6.283185	2
4.jpg	161	501	131624	185	629	30	18	4221	5105.049277	3.29894
5.jpg	166	674	13	167	675	50	13	1	0.966644	1.2
6.jpg	109	401	1	109	401	0	1	1	12.566371	1
7.jpg	183	495	168510	165	716	-81	10	5078	21175.59112	4.35542
8.jpg	120	405	2	119	405	0	2	1	6.283185	0.5
9.jpg	199	507	46	191	508	-4	36	1	0.446029	0.5
10.jpg	181	702	194087	169	724	-36	1281	3984	1.486305	4.46974
11.jpg	187	611	1027	165	606	28	455	1	0.062339	0.77778
12.jpg	213	319	280477	218	914	42	2978	8685	0.397427	4.15972
13.jpg	180	695	829	150	683	5	470	-6	0.047159	0.67123
14.jpg	111	1009	2	111	1009	45	2	1	6.283185	1
15.jpg	226	598	2392	224	606	-32	646	-13	0.072029	0.75

Chaunsa (Train Set)

S.No	Name	Row	Column	Area	Centroid_Row	Centroid_Col	Orientation	Perimeter	Euler Number	Thinness	Aspect Ratio
1	1.jpg	303	602	4	303	602	0	4	1	3.14159	0.666667
2	2.jpg	243	568	2	243	567	90	2	1	6.28319	2
3	3.jpg	319	618	59	319	614	16	69	0	0.15573	0.928571
4	4.jpg	320	348	3E+05	250	685	43	12913	795	0.02629	2.720532
5	5.jpg	80	122	9E+05	470	1025	-61	9215	5684	0.1389	2.346639
7	6.jpg	362	588	2	361	588	0	2	1	6.28319	0.5
8	7.jpg	437	886	9E+05	414	1063	-59	6143	7157	0.28774	2.630559
9	8.jpg	319	550	14	316	550	-20	17	1	0.60875	0.714286
10	9.jpg	474	853	29	476	854	6	37	1	0.2662	0.5
11	10.jpg	446	589	4E+05	320	696	-63	13509	13372	0.02827	2.339105
12	11.jpg	247	571	6	247	571	22	8	1	1.1781	0.6
13	12.jpg	275	399	4E+05	249	615	-25	3866	-11562	0.34959	2.631683

Maalda (Train Set)

S.No	Name	Row	Column	Area	Centroid_Row	Centroid_Col	Orientation	Perimeter	Euler Number	Thinness	Aspect Ratio
1	M1.jpg	190	539	1	190	539	0	1	1	12.5664	1
2	M2.jpg	207	328	320629	235	578	-62	4109	-4654	0.23864	2.543158
3	M3.jpg	323	626	1	323	626	0	1	1	12.5664	1
4	M4.jpg	291	623	358285	272	938	-61	15022	15076	0.01995	3.420108
5	M5.jpg	209	459	5	210	459	31	5	1	2.51327	0.666667
6	M6.jpg	297	408	9	296	408	-65	8	1	1.76715	1.666667
7	M7.jpg	288	368	1	288	368	0	1	1	12.5664	1
8	M8.jpg	282	439	276367	269	769	-30	6222	17050	0.08971	2.960217
9	M9.jpg	403	487	472201	309	927	30	5547	17635	0.19285	3.136223
10	M10.jpg	231	529	1	231	529	0	1	1	12.5664	1
11	M11.jpg	238	514	5	236	513	37	7	1	1.28228	0.75
12	M12.jpg	249	438	1	249	438	0	1	1	12.5664	1
13	M13.jpg	228	793	18	225	790	49	24	1	0.3927	1.428571
14	M14.JPG	202	498	56083	146	460	-72	1	9879	704760	3.022082
15	M15.JPG	197	304	245	203	294	-74	118	-17	0.22111	1.681818

RST-Invariant Features

RST-Invariant used to find seven moment-based rotation-scale-translations (rst)-invariant features for an image selected by the user using CVIPTools. To get the rst-invariant features, this function first find and normalizes central moments. This algorithm is designed to work on the binary image.

Rst_invariant([in] long* input_im1, [in] long r, [in] long c ,[out,retval] VARIANT *result_array);

RST-Invariant features of mango leaves of three types Anwar Ratol, Chaunsa and Maalda are extracted using CVIPTools. These features are given in these tables.

$$\phi_1 = \mu_{20} + \mu_{02}$$

$$\phi_2 = (\mu_{20} - \mu_{02})^2 + 4\mu_{11}^{\ 2}$$

$$\phi_3 = (\mu_{30} - 3\mu_{12})^2 + 3(\mu_{21} + \mu_{03})^2$$

$$\phi_4 = (\mu_{30} - \mu_{12})^2 + (\mu_{21} + \mu_{03})^2$$

$$\phi_5 = (\mu_{30} - 3\mu_{12})(\mu_{30} + \mu_{12})[(\mu_{30} + \mu_{12})^2 - 3(\mu_{21} + \mu_{03})^2] + (3\mu_{21} - \mu_{03})(\mu_{21} + \mu_{03})[3(\mu_{30} + \mu_{12})^2 - (\mu_{21} + \mu_{03})^2]$$

$$\phi_6 = (\mu_{20} - \mu_{02})[(\mu_{30} + \mu_{12})^2 - (\mu_{21} + \mu_{03})^2] + 4\mu_{11}(\mu_{30} + \mu_{12})(\mu_{21} + \mu_{03})$$

$$\phi_7 = (3\mu_{21} - \mu_{03})(\mu_{30} + \mu_{12})[(\mu_{30} + \mu_{12})^2 - 3(\mu_{21} + \mu_{03})^2] - (\mu_{30} - 3\mu_{12})(\mu_{21} + \mu_{03})[3(\mu_{30} + \mu_{12})^2 - (\mu_{21} + \mu_{03})^2]$$

RST-Invariant Features of Anwar Ratol (Train Set)

Name	Row	Column	RST1	RST2	RST3	RST4	RST5	RST6	RST7
1.jpg	102	666	0	0	0	0	0	0	0
2.jpg	272	769	0.189815	0.013396	0.000826	0.000216	0	0.000018	0
3.jpg	238	860	0.125	0.015625	0	0	0	0	0
4.jpg	161	501	1.188916	0.931751	0.000047	0.00164	0	0.001583	0
5.jpg	166	674	0.279472	0.034021	0.015213	0.006101	0.000058	0.001093	-0.000007
6.jpg	109	401	0	0	0	0	0	0	0
7.jpg	183	495	1.571103	1.989404	0.005418	0.007513	0.000048	0.010512	0.000001
8.jpg	120	405	0.125	0.015625	0	0	0	0	0
9.jpg	199	507	0.4662	0.161723	0.005919	0.000729	0.000001	0.000147	0.000001
10.jpg	181	702	1.496177	1.852492	0.084377	0.086366	0.007373	0.117229	-0.000019
11.jpg	187	611	0.294859	0.008104	0.000317	0.000163	0	0.000015	0
12.jpg	213	319	1.47783	1.751748	0.017328	0.01295	0.000194	0.017049	0
13.jpg	180	695	0.575507	0.065977	0.074202	0.00405	0.000057	0.000814	0.000041
14.jpg	111	1009	0.25	0.0625	0	0	0	0	0
15.jpg	226	598	0.327826	0.028142	0.00057	0.000014	0	-0.000001	0

RST-Invariant Features of Chaunsa (Train Set)

S.No	Name	RST1	RST2	RST3	RST4	RST5	RST6	RST7
1	1.jpg	0.171875	0.006104	0.003433	0.000015	0	-0.000001	0
2	2.jpg	0.125	0.015625	0	0	0	0	0
3	3.jpg	0.381996	0.004629	0.016509	0.000669	0.000002	0.000045	0.000002
4	4.jpg	0.65907	0.24633	0.001533	0.001993	0.000003	0.000963	-0.000001
5	5.jpg	0.648209	0.202718	0.004392	0.011609	0.000083	0.005224	0.000002
7	6.jpg	0.125	0.015625	0	0	0	0	0
8	7.jpg	0.677958	0.248989	0.00728	0.009348	0.000076	0.004633	-0.000014
9	8.jpg	0.475948	0.121362	0.026989	0.005433	-0.000009	-0.000885	-0.000065
10	9.jpg	0.478904	0.104217	0.001371	0.00127	0.000002	0.0001	0
11	10.jpg	0.808705	0.303564	0.033624	0.048012	0.001896	0.026272	-0.000356
12	11.jpg	0.37963	0.102966	0.016035	0.005214	0.000048	0.001634	0.000003
13	12.jpg	0.423333	0.098657	0.001165	0.001046	0.000001	0.000309	0

RST-Invariant Features of Maalda (Train Set)

S.No	Name	RST1	RST2	RST3	RST4	RST5	RST6	RST7
1	M1.jpg	0	0	0	0	0	0	0
2	M2.jpg	0.483295	0.125137	0.000523	0.000746	0	0.000253	0
3	M3.jpg	0	0	0	0	0	0	0
4	M4.jpg	1.18027	0.99395	0.000592	0.001619	0.000001	0.001573	-0.000001
5	M5.jpg	0.16	0.0064	0.001152	0.000128	0	0.00001	0
6	M6.jpg	0.208505	0.017462	0.001453	0.00009	0	0.000003	0
7	M7.jpg	0	0	0	0	0	0	0
8	M8.jpg	1.112759	0.780554	0.009581	0.011398	0.000119	0.009949	-0.000006
9	M9.jpg	1.012095	0.688858	0.028893	0.029935	0.00088	0.024283	-0.000028
10	M10.jpg	0	0	0	0	0	0	0
11	M11.jpg	0.336	0.071936	0.020238	0.003281	0.000015	0.000132	0.000022
12	M12.jpg	0	0	0	0	0	0	0
13	M13.jpg	0.560528	0.189384	0.019061	0.013031	0.000198	0.005581	0.000056
14	M14.JPG	1.988928	2.490072	0.062181	0.058217	0.003344	0.087791	-0.001041
15	M15.JPG	0.404912	0.065563	0.020327	0.001151	-0.000005	-0.000242	-0.000003

Classification

Identification of leaf images is the procedure which allocates name for image stand upon the information offered by its facial appearance. Classification is an incredibly helpful procedure utilized to identify the leaf images. Categorization is considered necessary to make a distinction of mango plant leaves with other mango plant leaves support on the data acquired from characteristic selection. Features from image data saved in catalog are compared to another feature from the inquiry image. Artificial Intelligence AI as well as fuzzy judgment is the most regularly procedures that are used in identification. There is some earlier research on leaf image processing using fuzzy classification. A nearer space between these descriptions was chosen to assign the inquiry image that is present in some class. Artificial Intelligence AI as well as fuzzy classifier is the mainly methods used into identification. There are a number of earlier researches on leaf image processing with fuzzy classification and artificial neural network (ANN) classifier.

Artificial Intelligence AI is a great method which is utilized to categorize as well as identify indefinite tests of images. AI is separated interested in two techniques organized and unorganized. Frequently, unorganized Artificial Intelligence has Hopfield Network, Competitive Learning and Self-Organizing Maps produces a graphical illustration and calculations are a lesser amount of difficulty. Organized AI includes Multilayer Perceptron, Back propagation and Radial Basis Method is non graphical and have need of top processing control. A benefit of unsubstantiated neural networks is that they present online identification.

During the pattern identification, earlier than training and testing of mango leaf images, every binary and RST-Invariant features were extorted. Mango leaves renovation applies in the feature collection to remove all achievable dependency. Furthermore, to learn the efficiency of the classification, dissimilar databases including images and features were utilized for training and testing.

This research contains the artificial intelligence that helps to approximate the a posteriori possibilities of a participation sample belong to every category. Particularly, I used Nearest Neighbor Algorithm with k=1 at Euclidean Distance. Dividing and integration of the images are depending on the possibility of every set.

The sample classification requires two files created with Analysis Features. One is used for the training set and one is used for the test set. The user also specifies the name of an output file which will contain the pattern classification results.

Classification Algorithm: Nearest Neighbor with k=1
Data Normalization: None
Distance Measure: Euclidean Distance

This could be done by determining the leaves image features that must be obtained for processing. Computer vision is essentially implemented in image processing systems for a particular purpose, so the characteristic extraction and pattern identification is an essential element of every computer visualization systems. The fundamental method of this device is to survey characteristic extraction and pattern identification that permit the client to execute group processing with huge image data sets and additional well-organized than processing single image at a time with CVIPtools. This let the client to choose the features and pattern identification parameters for the mechanical processing of these large image sets. CVIPTools facilitate the client to simply identify the training and test sets. It runs testing in a good way. Its fundamental principle is to get the most excellent parameters of methods for a particular purpose in arrange to achieve best classify outcomes of the mango image leaves images. This research with a collection of leave images that have binary masks has been shaped for the leaves image illustration. These masks can be produced yourself with CVIPtools or many further image database applications will have the masks obtainable. The user will load the images, identify the classes, choose the features, first-rate the test set, decide the pattern classification parameters and then allow the program process the complete image set. An output file will be produced with the results for the experiment.

Output File

The output file is a text file containing: 1) CVIPtools feature file header, 2) Pattern classification header, which contains fields for: Classification Algorithm, Data Normalization, Distance Measure, Test Set File name, Training Data Set File name, Normalized Training Data Set File name, Normalized Test Set File name, Output File name, and the following information for each feature vector: 1) Image Name in Test Set, 2) Object's row coordinate in Test Set, 3) Object's column coordinate in Test Set, 4) Class in Test Set, 5) Class in Training Set, 6) Value of Distance or Similarity Measure.

This output file contains the results of classification of images.

RESULTS AND DISCUSSION

The results are obtained based on total 60 leaf images. Leaf Images are processed by applying canny edge detection and morphological feature extraction methods. The results of the classification model are obtained by following CVIPTools based artificial neural network method.

The last section in the output file contains statistics for the test results. A table of success rates for each class, as well as how the misclassified feature vectors were classified is given.

The accuracy of classification varies from 96%- 98 depending on the algorithms and limitations of image acquisition.

Classification also is obtained with great accuracy as the case with image detection. In this case also the classification accuracy can be obtained up to 96% with correct imaging techniques and algorithms. The evaluation of processing system is increased. The processing of scattered system and hardware, in the image processing nearest neighbour and test/train algorithm of neural network for classification should be improved to achieve the capabilities of CVIPtools tools. So, I need an inner level of understanding to get parallelism. This is based on the investigation that has been made in producing corresponding image processing using ANN, I wind up the parallelism is also achievable for image processing in crop growing application for recognition.

Anwar Ratol

	FeatureFile H				
Image name	Object's row coo...	Object's column ...	Area	Centroid (row, col...	Orientation (Axis ...
Perimeter	Euler number	Projection (Heig...	Thinness	Aspect ratio	RST1
RST2	RST3	RST4	RST5	RST6	RST7
	Test Set Information				
Image Name	Object's row	Object's	Class in	Classificatior	Value of
1.jpg	1	1	A	A	23600.281250
2.jpg	1	1	A	A	425.862061
3.jpg	1	1	A	A	18296.291016
4.jpg	1	1	A	A	31144.525391
5.jpg	1	1	A	A	42157.589844

Chaunsa

	FeatureFile He				
Image name	Object's row coor...	Object's column c...	Area	Centroid (row, col...	Orientation (Axis ...
Perimeter	Euler number	Projection (Heig...	Thinness	Aspect ratio	RST1
RST2	RST3	RST4	RST5	RST6	RST7
	Test Set Information				
Image Name in	Object's row	Object's	Class in Test	Classification	Value of
1.jpg	347	783	C	C	159.316620
2.jpg	148	498	C	C	130.514404
3.jpg	97	400	C	C	229.978577
4.JPG	92	349	C	C	98955.593750

Maalda

	FeatureFile H				
Image name	Object's row coo...	Object's column ...	Area	Centroid (row, col...	Orientation (Axis ...
Perimeter	Euler number	Projection (Heig...	Thinness	Aspect ratio	RST1
RST2	RST3	RST4	RST5	RST6	RST7
	Test Set Information				
Image Name	**Object's row**	**Object's**	**Class in**	**Classificatior**	**Value of**
M1.jpg	250	839	M	M	56.825424
M2.jpg	359	735	M	M	121.117844
M3.jpg	291	526	M	M	68.687737
M4.jpg	339	474	M	M	92.576096
M5.JPG	174	355	M	M	111.865990

The classification results of mango plant leaves at 80 to 20 ratio is shown in the following tables.

Anwar Ratol 80/20 Ratio

Classificatioi Algorithm	Data Normalization	Distance Measure	Test Set File	Training Set File	Output File
	FeatureFile Heac				
Image name	Object's row coordin...	Object's column coor...	Area	Centroid (row, colum...	Orientation (Axis of le...
Perimeter	Euler number	Projection (Height: ...	Thinness	Aspect ratio	RST1
RST2	RST3	RST4	RST5	RST6	RST7
	Test Set Information				
Image Name in	**Object's row**	**Object's column**	**Class in Test**	**Classification**	**Value of**
1.jpg	1	1	A	A	23600.281250
2.jpg	1	1	A	A	425.862061

Chaunsa Results 80 to 20 ratios

	FeatureFile Hea				
Image name	Object's row coordi...	Object's column co...	Area	Centroid (row, colu...	Orientation (Axis of l..
Perimeter	Euler number	Projection (Height:...	Thinness	Aspect ratio	RST1
RST2	RST3	RST4	RST5	RST6	RST7
	Test Set Information				
Image Name in	**Object's row**	**Object's**	**Class in Test**	**Classification**	**Value of**
1.jpg	347	783	C	C	159.316620
2.jpg	148	498	C	C	130.514404

Maalda Classification 80:20 ratio

	FeatureFile Heac				
Image name	Object's row coordin...	Object's column coor...	Area	Centroid (row, column...	Orientation (Axis of le...
Perimeter	Euler number	Projection (Height: ...	Thinness	Aspect ratio	RST1
RST2	RST3	RST4	RST5	RST6	RST7
	Test Set Information				
Image Name in	**Object's row**	**Object's column**	**Class in Test**	**Classification**	**Value of**
M1.jpg	250	839	M	M	56.825424
M2.jpg	359	735	M	M	121.117844

CONCLUSION

This research proposed an automatic identification of mango plant leaves identification using shape features and RST-Invariant features of their leaves. The automated classification Algorithm of Artificial Neural Network can prove very useful for fast and efficient classification of mango plant leaves images. The accuracy rate of the current proposed approach is very efficient comparable to other discussed in literature review.

The Gabor filter and Roberts edge detector is used as the feature extraction. Feature selection is applied in this research. The existing literature and how the proposed method is applied explained. CVIP Tool is used here to extract the leaf features such as edge, binary and RST-Invariant where edge and binary are the visual attribute which can be used to describe the pixel organization in an image. From the experimental results it is observed that the Proposed Method has better classification accuracy than others. The accuracy of classification varies from 96%- 98 depending on the algorithms and limitations of image acquisition.

I reduced the classification features for results in faster execution speeds and identification success rate. The proposed image processing system consisting of the camera and frame grabber and operating under the control of the proposed GUI that invokes the image processing libraries, feature selection and neural network classification routines can be suitable for real-time operation in several application environments.

The proposed features selection approach results in simpler, faster and easier to train neural network architectures, when compared to artificial neural networks (ANNs) used to measure the of individual input features to the output of the neural network to get the output file of results.

Future Work

Next step in the future work, three selected classifiers will be tested based on our dataset and the results will be recorded. Only the better classifier will be used in our research. However, we may have to consider images that contain many leaves in order to test the ability of the classifiers.

Future work will include research along two directions:

1. Comparing textures base features
2. Color features for improving recognition accuracies.

An option used to consider in the future is to use color or texture, which has not been handled in this thesis. It is of course not without value towards the process of recognition. Blue oranges do not exist, nor is there a large possibility of finding an orange pear. Colors are not all that difficult to include in the object recognition process. I could supplement the shape interpretation or descriptor with color information, only slightly increasing its complexity. Interpreting texture is more difficult, since I cannot as easily classify textures as we can colors. But there are some techniques for working with textures. Gabor filters, for instance, have been used successfully in representing texture.

REFRENCES

[1] Lakshmi Dutta, Tapan Kumar Basu, ”Extraction And Optimization Of Leaves Images Of Mango Trees And Classification Using Ann” , International Journal of Recent Advances in Engineering & Technology (IJRAET), ISSN (online) 2347-2812 Volume-1, Issue-3, 2013.

[2] P.R. Eddy, A.M. Smith, B.D. Hill, D.R. Peddle, C.A. Coburn and R.E. Blackshaw, “Comparison of neural network and maximum likelihood high resolution image classification for weed detection in crops: Applications in precision agriculture” , 0-7803-9510-7/06/ IEEE © 2006 .

[3] Li Chen, Jin-Guo Zhang, Hai-Feng Su, Wei Guo, “Weed Identification Method Based On Probabilistic Neural Network In The Corn Seedlings Field”, Proceedings of the Ninth International Conference on Machine Learning and Cybernetics, Qingdao, 11-14 July 2010.

[4] M. Z. Rashad , B.S.el-Desouky , and Manal S .Khawasik, “Plants Images Classification Based on Textural Features using Combined Classifier”, International Journal of Computer Science & Information Technology (IJCSIT) Vol 3, No 4, August 2011.

[5] Abdul Kadir, Lukito Edi Nugroho, Adhi Susanto, Paulus Insap Santosa, “Leaf Classification Using Shape, Color, and Texture Features”, International Journal of Computer Trends and Technology- July to Aug Issue 2011.

[6] R. Hussin, M. Rizon Juhari, Ng Wei Kang, R.C.Ismail, A.Kamarudin, “Digital Image Processing Techniques for Object Detection From Complex Background Image”, International Symposium on Robotics and Intelligent Sensors 2012 (IRIS 2012).

[7] Panitnat Yimyam, Thanarat Chalidabhongse, Panmanas Sirisomboon, and Suwanee Boonmung, “Physical Properties Analysis of Mango using Computer Vision”, June 2-5, KINTEX, Gyeonggi-Do, Korea, ICCAS2005, 2005

[8] Pallavi P, V.S Veena Devi, “Leaf Recognition Based on Feature Extraction and Zernike Moments”, International Journal of Innovative Research in Computer and Communication Engineering, Vol.2, Special Issue 2, May 2014

[9] Ekshinge Sandip Sambhaji, D.B Andore, “ Leaf Recognition Algorithm Using Neural Network Based Image Processing”, Asian Journal of Engineering and Technology Innovation, 2014

[10] Vijayashree.T, Dr. A.Gopal, “Leaf Image Processing- Review”, Proceedings of ICSEM‘14- 2nd International conference on science, Engineering and management, Srinivasan Engineering college, Tamil Nadu, India, March 28-29,2014

[11] Stephen Gang Wu, Forrest Sheng Bao, Eric You Xu, Yu-Xuan Wang, Yi-Fan Chang and Qiao-Liang Xiang, “A Leaf Recognition Algorithm for Plant Classification Using Probabilistic Neural Network”, arXiv:0707.4289v1 [cs.AI], 29 Jul 2007

[12] Manisha Amlekar, Dr. Ramesh R Manza, Dr. Pravin Yannawar and Dr. Ashok T Gaikwad, “Leaf Features Based Plant Classification Using Artificial Neural Network”, IBMRD's Journal of Management and Research, Volume-3, Issue-1, March 2014

[13] Alireza Pazoki, Zohreh Pazoki, Farzad Paknejad, “Leaf identification of sesame varieties using artificial neural networks (MLP and Neuro-Fuzzy)”, International Journal of Biosciences | IJB |, 2013

[14] Sandeep Kumar.E, "A Novel Neural Network Based Approach for the Classification of Betel Leaves", International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 1, Issue 2, July – August 2012

[15] Anant Bhardwaj, Manpreet Kaur, and Anupam Kumar, "Recognition of plants by Leaf Image using Moment Invariant and Texture Analysis", International Journal of Innovation and Applied Studies ISSN 2028-9324 Vol. 3 No. 1, pp. 237-248, May 2013

[16] Jyotismita Chaki, Ranjan Parekh, "Plant Leaf Recognition using Shape based Features and Neural Network classifiers", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 2, No. 10, 2011

[17] Mohamad Faizal Ab Jabal, Suhardi Hamid, Salehuddin Shuib And Illiasaak Ahmad, "Leaf Features Extraction And Recognition Approaches To Classify Plant", Journal Of Computer Science 9 (10): 1295-1304, 2013

[18] C.S.Sumathi, A.V.Senthil Kumar, "Neural Network based Plant Identification using Leaf Characteristics Fusion", International Journal of Computer Applications (0975 – 8887) Volume 89 – No.5, March 2014

[19] Petr Novotny, Toma´s Suk, "Leaf recognition of woody species in Central Europe", bio systems engineering115, 2013

[20] Dr. V.S.Rajpurohit, Shruti Bhat, Shreya Devurkar, Shubhangi Patil, Supriya Sirbi, "Application of Image Processing Techniques in Object Shape Recognition", International Journal of Latest Trends in Engineering and Technology (IJLTET), 2013

[21] Christopher Rasmussen. Combining laser range, color, and texture cues for autonomous road following. In Proc. IEEE Inter. Conf. on Robotics and Automation, Washington, DC, 2005.

[22] M. Ollis and A. Stentz. Vision-based perception for an automated harvester. Proceedings of IEEE/RSJ International Conference on Intelligent Robotic Systems (IROS 97), 1997.

[23] Sklansky J. Image segmentation and feature extraction. IEEE Transactions on Systems, Man, and Cybernetics, SMC-8, 1978.

[24] Duin R. Jain A. and Mao J. Statistical pattern recognition: A review. IEEE Transactions on Pattern Analysis and Machine Intelligence, 22:4–37, 2000.

[25] J.Martí J.Freixenet, X.Muñoz and X. Lladó. Colour texture segmentation by region boundary cooperation. In European Conference on Computer Vision, 2004.