International Journal of Advanced Computer Research (ISSN (print): 2249-7277 ISSN (online): 2277-7970)
Volume-4 Number-1 Issue-14 March-2014

A Real Time based Physiological Classifier for Leaf Recognition

Avinash Kranti Pradhan[1], Pratikshya Mohanty[2], Shreetam Behera[3]

Abstract

Plants are everywhere around us. They possess many vital properties necessary for human survival. The lack of knowledge about plants and the global shortage of agricultural experts have inspired the need to create automation in the process of identification of leaves. The recognition of plants can be done by considering the basic physiological features of leaves. This paper has proposed a real time based identification system for recognising different varieties of leaves along with important details about the plant. Here the leaf image is pre-processed from which different features are extracted and are fed to a physiological based recognition system for leaf identification. This is a simple approach which gives accurate results under any conditions.

Keywords

Feature extraction, Physiological features, Pre-process, Physiological based recognition system.

1. Introduction

Plants occupy a major portion of our ecosystem. They are a source of oxygen, food, fuel, raw materials, shelter, clothing, medicines etc. They play a pivotal role for the survival of different living creatures and maintain a balance in the ecosystem. Some plants possess medicinal property while some other is poisonous. Even there are many varieties of plants which are at the verge of extinction. Thus it is important to maintain a database which will prevent the plants from being extinct and will serve as a source of knowledge base, carrying significant information about the plant.

Manuscript received March 23, 2014.
Avinash Kranti Pradhan, Electronics & Communication Engineering, Centurion University of Technology & Management, Jatni, India.
Pratikshya Mohanty, Electronics & Communication Engineering, Centurion University of Technology & Management, Jatni, India.
Shreetam Behera, Electronics & communication Engineering, Centurion University of Technology & Management, Jatni, India.

In this study, a real time based leaf recognition system is proposed to identify different varieties of leaves based on their basic physiological features. The extracted features form a database, which are fed to a physiological classifier for recognition of leaves.

Several researchers have developed many algorithms for the recognition of different plant species. In [1], a plant identification system has been created that used features such as slimness ratio, roundness ratio, solidity, invariant moments and features to represent leaf dent and vein. This system was able to recognize six kinds of different plants.

A system has been designed and implemented in which different geometric and morphological features are extracted from plant leaves [2]. This system uses image processing based algorithms and machine learning techniques.

The concept of computer vision was applied in the field of agriculture mainly for non- destructive testing of leaves, flowers, fruits and vegetables [3], [4]. In [5], a novel technique has been proposed which uses color features to segregate rotten vegetables from a mixture of fresh and rotten ones. Two color textures are taken into consideration i.e. green and yellow. [6] Presents a paper on detection of defects in fruits by feature extraction. The algorithm has been designed in such a way that the weights for different features are being calculated.

A method has been implemented towards identification of leaves using feature extraction and Probabilistic neural network (PNN) where the extracted features are fed as input to PNN. This algorithm could recognize 32 different kinds of plants [7]. In [8], an approach has been proposed to implement leaf recognition system which uses leaf vein and shape as the basis for classification. The main vein and the frequency domain data have been taken into consideration using Fast Fourier Transform. A methodology has been developed for the classification of betel leaves which uses both feature extraction and application of machine learning technique [9]. Paper [10] presents a method for medicinal plants identification based on its leaf features such as area and edge.

2. Proposed Methodology

2.1. Image Acquisition

The real time image of leaves has been captured using a webcam (Vimicro USB2.0 UVC PC Camera). The images are taken from the top with white background.

12 different varieties of leaves are taken. The samples of leaf images are shown in Fig.1.

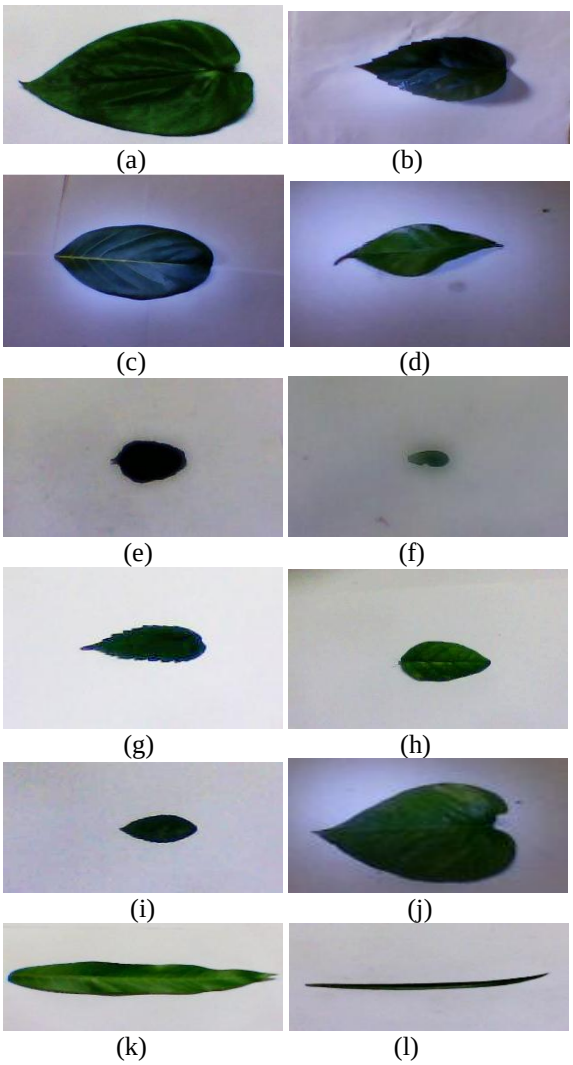

Fig.1: Leaf samples (a) Betel (b) Hibiscus (c) Jackfruit (d) Tagar (e) Basil (f) Brahmi (g) Neem (h) Jasmine (i) Rose (j) Money plant (k) Mango (l) Yellow Oleander

2.2. Image Pre-processing

2.2.1. Conversion of RGB to Gray scale image

The RGB image of the leaf is converted to gray scale image by using the following formula:

Gray scale image= red component * 0.3 + green component * 0.59 + blue component * 0.11 (1)

The gray scale image is then, converted to black and white.

2.2.2. Application of Max filter

Max filtering is applied for noise reduction and making the image smooth.

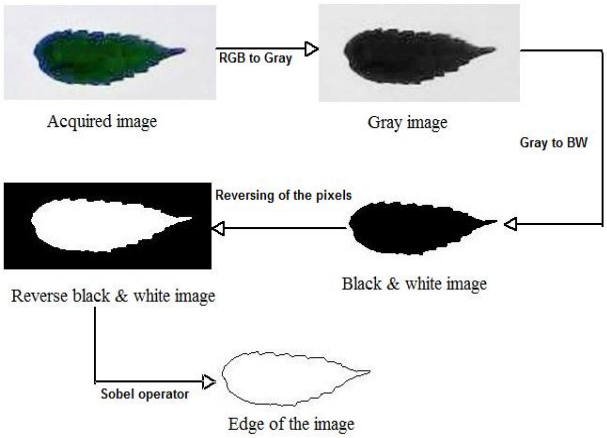

Fig.2: Pre-processing of leaf image

2.3. Feature Extraction

26 leaves of each class are taken and the five basic physiological features i.e. perimeter, area, length, width and aspect ratio are extracted as follows:

2.3.1. Area

The leaf area is calculated by counting the total number of pixels in the region of leaf. The calculated value is divided by 100 to obtain a finite value.

Algorithm for calculating area:
Step 1: Start
Step 2: Acquire the real time image of the leaf
Step 3: Convert color image to gray scale
Step 4: Convert gray scale image to black and white
Step 5: Count the number of pixels in the leaf region
Step 6: Store the value in a database
Step 7: Stop

2.3.2. Perimeter

The perimeter of a leaf is calculated by counting the number of pixels in the edge of the leaf. Sobel operator is used for edge detection.

Algorithm for calculating the perimeter:
Step 1: Start
Step 2: Acquire the real time image of the leaf

Step 3: Convert color image to gray scale
Step 4: Convert gray scale image to binary
Step 5: Apply Sobel operator and find its edge
Step 6: Count the number of pixels on the edge
Step 7: Store the value in a database
Step 8: Stop

2.3.3. Length

The distance between the two ends of the main vein of leaf is called its length.

2.3.4. Width

The leaf width is defined as the distance between the intersection point with length at the centroid and its opposite side on the margin of the leaf.

2.3.5. Aspect ratio

It is the ratio of leaf length to leaf width. The obtained value is multiplied by 1000 to get a whole number instead of fraction.

Aspect ratio= Length of leaf/ Width of leaf (2)

2.4. Database Creation

The five physiological features of 26 leaves of each individual class are stored in a database. The flow chart of feature database creation is shown in Fig.3.

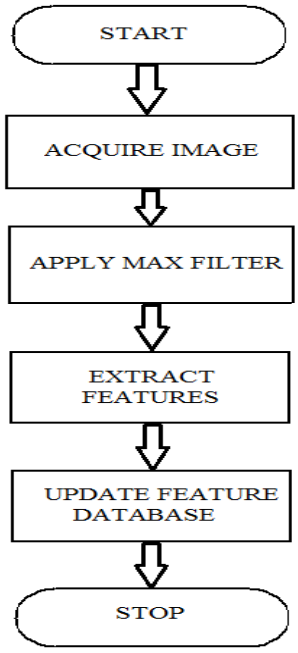

Fig.3: Feature Database Creation

The feature database of different class of leaves is shown:

I. Mango leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
634	648	296	60	202
607	626	295	70	237
589	626	293	71	242
545	665	271	55	202
469	677	233	55	236
534	665	264	56	212
450	695	221	55	248
610	644	302	63	208
394	705	194	44	226
469	691	232	45	193
400	705	197	46	233
494	681	245	59	240
573	648	284	61	214
383	716	191	42	219
513	646	246	67	272
534	658	264	58	219
478	654	225	69	306
564	648	281	64	227
536	656	259	59	227
547	664	269	52	193
582	633	288	66	229
593	636	294	67	227
573	647	286	61	213
371	716	183	40	218
557	662	272	56	205
585	647	291	60	206

II. Yellow Oleander leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
444	751	221	23	104
450	745	226	30	132
344	757	171	23	134
467	747	232	34	146
468	747	233	31	133
517	742	257	25	97
401	743	200	28	140
608	725	290	27	93
477	738	237	25	105
607	732	300	37	123
476	750	236	27	114
486	743	241	24	99
564	738	281	37	131
528	739	263	34	129
463	744	230	17	73
460	752	230	44	191
555	740	276	40	144
571	741	285	37	129
523	746	260	46	176
440	746	218	45	206
499	746	249	55	220
545	746	271	44	162
556	732	276	34	123
522	747	260	27	103
383	752	191	23	120

475	749	241	19	78

III. Betel leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
491	575	207	136	657
603	528	224	164	732
509	576	204	140	686
541	562	213	146	685
559	521	224	162	723
543	548	220	153	695
493	580	192	145	755
507	580	196	144	734
524	553	196	162	826
548	557	211	147	696
414	637	172	109	633
526	581	201	140	696
480	607	192	127	661
527	570	209	141	674
504	567	195	146	748
618	479	242	183	756
645	437	241	194	804
624	466	259	177	683
661	457	250	189	756
567	529	220	165	750
629	462	252	187	742
624	461	250	180	720
552	549	216	158	731
652	433	250	199	796
638	458	245	191	779
616	465	239	182	761

IV. Basil leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
104	759	45	26	577
113	757	49	28	571
89	761	38	22	578
114	760	48	21	437
119	758	48	29	604
94	760	41	23	560
115	758	49	25	510
127	755	54	32	592
108	758	47	25	531
130	756	55	28	509
104	759	46	27	586
85	762	38	17	447
95	761	39	20	512
111	759	49	24	489
88	762	38	20	526
84	762	36	18	500
83	763	36	18	500
127	755	50	35	700
76	763	33	18	545
91	762	41	20	487
142	754	61	31	508
87	762	40	17	425
136	754	59	31	525
94	762	43	19	441
99	760	42	25	595
90	761	40	23	575

V. Neem leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
240	733	111	45	405
224	740	110	40	363
262	743	124	38	306
286	725	139	49	352
165	749	79	35	443
153	753	72	29	402
163	751	76	33	434
191	747	87	36	413
193	744	90	37	411
196	742	91	43	472
221	737	102	44	431
207	742	93	41	440
155	752	74	30	405
185	742	82	44	536
169	749	80	33	412
201	743	91	40	439
196	741	90	41	455
149	755	71	28	394
205	742	94	39	414
196	740	90	45	500
239	728	115	49	426
193	747	89	35	393
172	749	77	36	467
169	748	79	36	455
173	747	76	37	486
238	734	110	44	400

VI. Hibiscus leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
324	690	117	91	777
320	700	116	84	724
334	682	129	97	751
305	699	112	88	785
321	693	123	87	707
354	678	132	101	765
331	688	123	95	772
256	717	102	71	696
387	657	145	114	786
373	660	143	107	748
322	686	125	95	760
454	651	158	111	702
459	633	170	119	700
380	664	148	107	722
318	690	120	93	775
313	700	117	84	717
385	658	143	108	755
393	674	137	99	722

366	674	134	100	746
339	677	123	103	837
342	684	128	95	742
362	670	121	107	884
373	666	143	106	741
418	646	147	116	789
371	665	139	110	791
385	659	152	108	710

VII. Jackfruit leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
457	597	199	121	608
430	628	195	103	528
477	581	197	125	634
421	633	177	103	581
430	629	186	103	553
415	631	181	104	574
405	642	174	100	574
412	640	179	99	553
411	647	176	92	522
420	635	183	96	524
461	601	198	114	575
407	635	165	107	648
443	618	195	108	553
417	637	177	100	564
423	625	186	106	569
414	637	175	103	588
420	640	183	97	530
400	648	167	97	580
428	641	187	91	486
400	639	166	104	626
453	599	187	120	641
455	607	196	112	571
417	629	173	107	618
391	654	164	92	560
368	658	154	97	629
351	673	147	91	619

VIII. Tagar leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
408	701	181	63	348
279	737	133	42	315
233	740	111	48	432
284	731	138	49	355
255	744	107	37	345
563	686	201	72	358
330	706	159	68	427
305	722	150	52	346
415	734	155	43	277
237	741	115	37	321
375	709	187	57	304
390	699	192	58	302
293	735	145	40	275
270	737	122	42	344
261	735	126	45	357
225	734	106	52	490
358	714	177	50	282
293	729	137	48	350
209	750	104	30	288
285	728	131	50	381
207	744	101	36	356
319	735	135	44	325
259	732	125	47	376
368	700	180	63	350
257	730	125	48	384
364	697	168	46	392

IX. Rose leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
144	751	66	35	530
175	746	80	39	487
194	739	88	47	534
167	746	75	39	520
209	738	97	47	484
202	738	95	46	484
144	751	66	35	530
155	751	70	33	471
169	745	75	41	546
137	754	64	30	468
163	746	73	41	561
162	748	73	38	520
146	751	66	35	530
157	751	74	33	445
148	753	66	32	484
137	753	56	36	642
160	749	72	37	513
198	739	91	45	494
169	745	75	42	560
143	753	63	35	555
154	749	68	38	558
162	748	74	39	527
164	746	73	41	561
152	750	70	37	528
153	750	72	36	500
176	745	82	40	487

X. Jasmine leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
262	716	110	65	590
297	699	123	77	626
242	720	105	64	609
270	710	109	73	669
283	703	121	79	652
288	701	115	78	678
240	725	102	59	578
228	724	99	62	626
249	721	103	66	640
249	728	110	72	654
234	725	107	59	551
205	732	89	57	640

204	733	89	53	595
220	729	98	57	581
235	723	95	66	694
306	693	133	82	616
250	716	104	69	663
267	713	108	73	675
240	725	102	59	578
237	720	84	70	833
250	721	103	66	640
295	703	122	74	606
228	726	95	59	621
261	715	116	62	534
267	713	121	63	520
284	710	121	63	520

XI. Brahmi leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
73	765	28	11	392
66	765	31	12	387
70	765	33	12	363
54	765	24	11	458
55	766	24	10	416
75	764	35	12	342
82	763	38	14	368
86	763	41	14	341
70	765	32	11	343
74	764	36	14	388
74	765	35	12	342
62	765	30	11	366
58	765	26	11	423
57	765	25	10	400
66	765	31	11	354
66	766	30	10	333
61	766	28	9	321
69	765	34	9	264
52	766	24	8	333
61	765	29	10	344
47	766	22	7	318
72	765	34	10	294
49	766	23	7	304
73	765	35	10	285
52	766	24	10	416
59	766	27	9	333

XII. Money plant leaf database

Peri-meter	Area	Width	Length	Aspect Ratio
470	607	181	137	756
332	690	129	89	689
413	692	141	84	595
376	689	163	79	484
405	671	146	103	705
462	634	161	124	770
318	686	128	93	726
259	717	107	72	672
316	699	122	85	696
422	643	161	118	732
374	666	152	101	664
391	662	156	107	685
390	673	148	94	635
265	717	98	77	785
281	717	105	76	723
291	725	99	66	666
252	721	83	74	891
261	719	100	73	730
368	679	133	101	759
292	709	113	82	725
244	718	91	75	824
285	703	110	78	709
277	707	105	82	780
284	710	113	77	681
257	717	95	75	789
239	728	94	62	659

2.5. Physiological based classifier

Experimentally the maximum and minimum values of each feature of different class of leaves are found from the database and a range is defined for each feature for a particular class of leaf.When a real time test image is captured using a webcam, it is pre-processed and its features are extracted. These extracted features are compared with the different range defined for each feature in the physiological classifier. The leaves, whose features match with the defined range, are identified and detail information about the particular plant such as its scientific name, uses etc. is provided.

If an image of leaf is captured which is not there in the database, its features would not match with any of the defined range and hence the system will show "Leaf is not recognized".

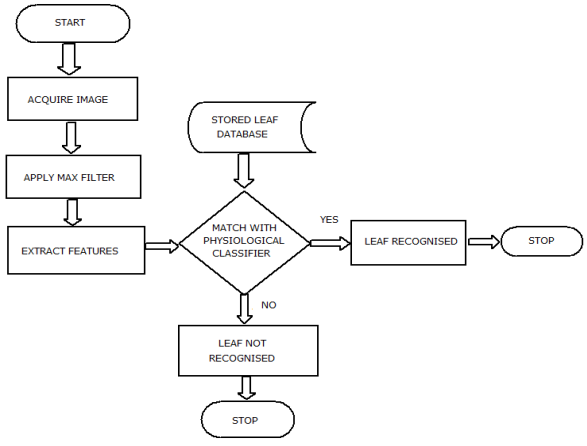

Fig.4: Testing using Physiological classifier

3. Results

When a real time image of a leaf from any of the above 12 varieties is taken for identification purpose, its features are extracted and are compared with the defined range. The system is thus, able to recognize the particular leaf. Since the dataset consists of 26 leaves from each class, it is sufficient enough to study the variation in leaf features. If the particular leaf is not present in the dataset, the system would not be able to recognize the leaf.

Fig.5: Rose leaf is identified

Fig.6: mango leaf is identified

Fig.7: Money plant leaf is identified

Fig.8: Betel leaf is identified

Fig.9: Brahmi leaf is identified

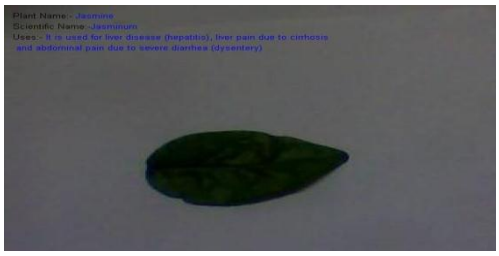

Fig.10: Jasmine leaf is identified

Fig.11: Jackfruit leaf is identified

Fig.12: Yellow Oleander leaf is identified

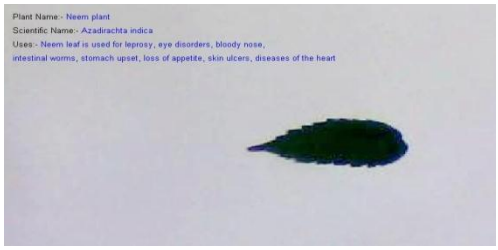

Fig.13: Neem leaf is identified

Fig.14: Basil (Tulsi) leaf is identified

Fig.15: Tagar leaf is identified

Fig.16: Hibiscus leaf is identified

Fig.17: Leaf is not recognized

4. Conclusion

This paper introduces a novel approach towards identification of leaves using physiological classifier. The method is implemented using real time images of leaves in MATLAB platform version 7.0. It has been found that the proposed system reduces time since there is no need to train the system unlike other complex algorithms. The results are found to be accurate and the accuracy of the system increases with increase in the number of features. Thus, the proposed algorithm is simple, cheap, fast in execution and easy to implement.

References

[1] Wu, Q., Zhou, C., & Wang, C., "Feature Extraction and Automatic Recognition of Plant Leaf Using Artificial Neural Network", Advances en Ciencias de la Computacion, pp.5-12, (2006).

[2] Panagiotis Tzionas, Stelios E. Papadakis and Dimitris Manolakis, "Plant Leaves Classification based on morphological features and fuzzy surface selection technique", 5th International Conference on Technology and Automation ICTA'05, Thessaloniki, Greece, pp.365-370, 15-16, (2005).

[3] Xiao'an Bao, Ruilin Zhang, "Apple grade Identification method based on artificial neural network and image processing", Transactions of the CSAE 20(3), pp.109-112, (2004).

[4] Tom Pearson, "Machine Vision System for automated Detection of stained pistachio nuts", Lebensmittel- Wissenschaft & Technology 29, pp. 203-209, (1996).

[5] Pratikshya Mohanty, Avinash Kranti Pradhan, Shreetam Behera, "A Real time based Image Segmentation Technique to Identify Rotten Pointed Gourds", International Journal of Engineering and Innovative Technology 3(4), pp.144-148, October (2013).

[6] Hetal N Patel, Dr. R.K.Jain and Dr. M.V.Joshi, "Fruit Detection using Improved Multiple Features based Algorithm", International Journal of Computer Applications 13(2), pp. 1-5, January (2011).

[7] Stephen Gang Wu, Forrest Sheng Bao, Eric You Xu, Yu- Xuan Wang Yi- Fan Chang, "A Leaf Recognition Algorithm for Plant Classification Using Probabilistic Neural Network", IEEE 7th International Symposium on Signal Processing and Information Technology, (2007).

[8] Kue-Bum Lee and Kwang-Seok Hong, "An Implementation of Leaf Recognition System using Leaf Vein and Shape", International Journal of Bio-Science and Bio-Technology, 5(2), pp.57-66, April (2013).

[9] Sandeep Kumar.E, "A novel Neural network based approach for the Classification of Betel Leaves", International Journal of Emerging Trends & Technology in Computer Science, 1(2), pp.10-16, August (2012).

[10] Sandeep Kumar.E, "Leaf Color, Area and Edge features based approach for Identification of Indian Medicinal Plants", International Journal of Computer Science and Engineering, 3(3), pp.436-442, July (2012).

Avinash Kranti Pradhan is pursuing his B.Tech in Electronics & Communication Engineering from Centurion University of Technology & Management, Jatni, Odisha. He is in his final year. His interst areas include Image Processing & Embedded Systems.

Pratikshya Mohanty is pursuing her B.Tech in Electronics & Communication Engineering from Centurion University of Technology & Management, Jatni, Odisha. She is in her final year. Her interst areas include Image Processing & Embedded Systems.

Shreetam Behera is presently working as Assistant Professor in the Department of Electronics and Communication Engineering at Centurion University of Technology and Management, Jatni, Odisha. He passed his Masters in Technology in Electronics and Instrumentation Engineering from the Siksha 'O' Anusandhan University, Bhubaneswar, Odisha in the year 2012 .He did his Bachelor of Technology in Electronics and Communication engineering in the year 2010 from Gandhi Institute of Engineering and Technology, Gunupur, Rayagada, Odisha, India. His research areas include Image Processing, Signal Processing and Embedded Systems.