Identification of Images Using Digital Image Processing

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Abstract

General image identification is essential in many applications. Defects identification in industries is mostly manual and time consuming. To reduce error in detecting defects, image identification can be used in industries. Moreover, India being an agro-based economy, farmers experience a lot of problem in detecting and preventing the diseases due to insects in agricultural fields. So there is a necessary in detecting insects in agricultural fields which proves to be effective and convenient for researchers. The images of the, insects or leaves are used to identify the insects or diseases affecting the leaves. The general image recognition method used in this study is based on Otsu's threshold value.

Keywords: ***Image segmentation, Otsu's threshold value***

1. Introduction

Images form important data and information in many science fields. Until recently photography was the only method to reproduce and report such data. It is difficult to quantify or treat the photographic data mathematically. Digital image processing and image analysis technology based on the advances in microelectronics and computers circumvent these problems associated with traditional photography. This new tool helps to improve the images from microscopic to telescopic range and also offers a scope for their analysis. It, therefore, has many applications in sciences especially in biology. However, as is the case with any new technology, imaging technology also has to be optimized for each application, since what each user is looking for in an image is quite unique [6,7]

Several applications of image processing technology for biology and agriculture have been developed in the collaborative programmes involving scientists and engineers from Electronics Systems Division, Computer Division, Molecular Biology & Agriculture Division, Nuclear Agriculture & Biotechnology Division and Cell Biology Division. These applications involve use of the camera based hardware systems or color scanners for inputting the images.

This paper is organized as follows. In section II, we review the literature in the area of image identification. In section III, we give the proposed Otsu's image identification algorithm. In section IV, we give the application of this algorithm in two different fields and section V we provide the conclusion and future work for this paper.

2. Literature Review

2.1. Image recognition methods

The shape of an image is an important feature for certain image recognition application. There are two criteria for representing the shape of an image: (a) the shape descriptors should be sufficiently accurate so that they uniquely represent that shape and (b) the shape descriptor should be broad enough to be insensitive to minor variations among objects of the same type. This applies, in particular, to biological objects since they are irregular. The shape of objects can be represented by different methods which are generally classified under two major categories of shape representation: (a) the boundary-based and (b) region-based methods. Boundary-based representations utilize only the information of the shape boundary whereas the region-based techniques consider the internal and external details of the shape. Fourier descriptors and String matching methods were implemented as boundary-based method. Geometric moments, Zernike moments and Region properties were selected from Region-based method. In addition to these methods, the Normalized cross correlation method was, also, employed [1].

2.2. Image recognition by Zernike moments

Zernike moment descriptor has the properties of rotation invariance, robustness to noise, expression efficiency, fast computation and multi-level representation for describing the various shapes of patterns. Zernike moments introduce a set of complex polynomials which form a complete orthogonal set over the interior of a circle [1].

The Zernike moments are computed for an image by considering the center of the image as the origin and the pixel coordinates are mapped to the range of the unit circle. The computation will not include pixels outside the unit circle. The orthogonality implies no redundancy or overlap of information between the moments with different orders and repetitions. In this case, each moment will be a unique and independent representation to a given image. Zernike moments have been utilized as feature sets in applications such as pattern recognition, content-based image retrieval, and other image analysis systems In many comparison studies of moments based methods Zernike moments outperformed the others methods.

2.3. Matching by strings

In this method, the boundary of an image is represented by a string which is generated by coding the interior angles of the polygons. For an input image of unknown image and identifying image, the two boundaries can be coded into strings a1,a2,…an and b1,b2 …bn respectively and that strings are compared to recognize the image. Strings are perfectly matched if the two images are identical [1].

2.4. Image recognition by Fourier descriptors

Fourier descriptors are produced by the Fourier Transformation which represents the shape in the frequency domain [1, 3, 4]. The lower frequency descriptors store the general information of the shape and the higher frequency components account for fine details. Therefore, the lower frequency components of the Fourier descriptors are sufficient for general shape description. Therefore, not all Fourier descriptors are required for general object recognition. Instead, only the first P coefficients are sufficient to describe the shape of an image.

2.5. Regional properties descriptors

. A regional property is one of the approaches among regional descriptors as it deals with the region(s) of the image instead of its boundary. It is a simple method for describing important properties of image regions such as: the area, centroid and orientation. The aim of this work is to identify particular image among other images and desired to keep a system as simple as possible.

3. Proposed Otsu’s image identification Algorithm:

Global thresholding uses only one threshold value, which is estimated based on statistics or heuristics on global image attributes, to classify image pixels into foreground or background. The major drawback of global thresholding techniques is that it cannot differentiate those pixels which share the same gray level but do not belong to the same group. Otsu’s method is one of the best global thresholding methods. It works well with dearly scanned images. [2, 3, 4].

Otsu's thresholding method involves iterating through all the possible threshold values and calculating a measure of spread for the pixel levels each side of the threshold, i.e. the pixels that either falls in foreground or background to find the threshold value where the sum of foreground and background spreads is at its minimum.

Because of intuitive properties and simplicity of implementation image thresholding enjoys a central position in applications of image identification [3]. But it performs unsatisfactorily for those poor quality images that have low contrast and non-uniform illumination.

The steps for the proposed Otsu’s algorithm for image identification are as follows.

Step 1.Load the Reference RGB image

Step 2. Separate the R, G and B components and find the Otsu’s threshold values and store it in an array X

Step 3. Load the new Test image.

Step 4. Separate the R, G and B components of Test image and find the Otsu’s threshold values and store it in an array Y.

Step 5. Calculate the correlation between X and Y and store it in C.

Step 6. If ABS (1-C) $\leq$ TH (Acceptable difference) recognize the image is the identifying image else don’t recognize the image. Go to step 3.

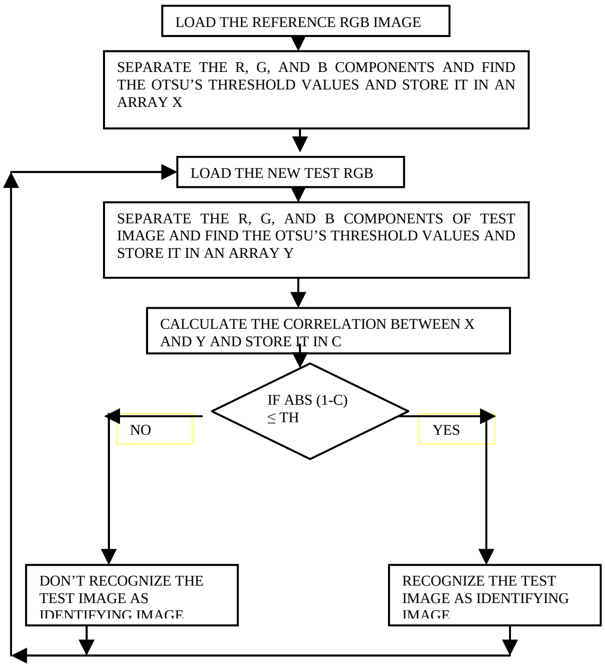

Figure1. Otsu's Image Identification algorithm

4. Applications of Otsu's Image Identification Algorithm.

4.1 Application to Insect Identification

S.M.Al-Saqer et.al in [1] concluded that a combination of more than one method is essential for a robust recognition system since no single method, such as Normalized Cross Correlation, Fourier Descriptor, Zernike moments, String matching and Region properties, yield the desired result of 100% recognition rate. They combined Zernike moment of order 3 and Region properties to achieve 100% recognition rate. But even slight distorted insect images show large variations in Zernike moment values and hence the insects with slight distortions are not recognized. This drawback overcome by using Otsu's threshold value and gives 100% recognition. Generally, the Otsu's threshold value used only for image segmentation purpose; but in this work, we used this threshold value to identify the images.

The acceptable difference (TH) in correlation value at which insects are recognized as identifying insect was experimentally determined using 30 different insect images with difference of 0.000005.

Table I shows the Correlation values based on Otsu's threshold values of different insect images with respect to Insect No 1.

Table II shows the distortion of the same insect with different distortions. But the correlation shows that the distortions won't affect the identification of the insects.

The processing time requirement of this proposed algorithm depends upon the size of the image processed. The size of the image 150 X 150 pixels, the average time requirement is 1.3 seconds and if the size is 250 X 250 pixels, the time requirement is 2.9 seconds. Thus the processing time directly depends upon the size of the image and the time complexity analysis shows that the processing time is less compare to algorithm in [1].

4.2 Application to Disease Identification in Leaves

In this paper Figure 2 shows the image of a normal leaf and Figure 3 shows the image of disease affected leaf. The correlation value shows the abnormal difference between normal and disease affected leaf. The Table III shows the correlation values of diseased leaf. The vast difference in the normal and diseased leaf indicates that there is a strong relationship between the intensity of disease and the correlation value. Appropriate correlation difference is very important to separate the normal and diseased leaf. Naked eye observation itself shows that the red component increases in the diseased leaf which in turn changes the correlation value from the normal leaf.

TABLE I
Correlation values for different insects with respect to insect no 1.

INSECT	CORRELATION VALUE	INSECT	CORRELATION VALUE
insect1	1	insect16	0.998161797
insect2	0.383682522	insect17	0.72375017
insect3	0.72291115	insect18	-0.4586162
insect4	0.984676541	insect19	0.73578049
insect5	0.834113065	insect20	0.652117926
insect6	0.996900528	insect21	0.937873788
insect7	0.989416564	insect22	0.869592909
insect8	0.998128839	insect23	0.627630246
insect9	0.999543295	insect24	0.972597799
insect10	0.607611406	insect25	0.794202511
insect11	0.834113065	insect26	-0.471870483
insect12	0.652117926	insect27	0.936909319
insect13	-0.171826714	insect28	0.989412574
insect14	0.895856912	insect29	0.999543295
insect15	0.999590353	insect30	0.879374704

TABLE II
Correlation values for same insect with different distortions

INSECTS	CORRELATION W.R.TO NORMAL INSECT
Normal	1
With Noise	0.99997553
Rotation 180^0	1
Size reduction	1

Correlation value = 1
Figure2. Normal Leaf image

Correlation value = 0.9577
Figure3. Disease affected Leaf image

TABLE III
Correlation value of same leaf with different diseases

SAME LEAF WITH DIFFERENT DISEASE	CORRELATION VALUE
Disease 1	**0.957686075**
Disease 2	**0.758532618**
Disease 3	**0.815136474**
Disease 4	**-0.364076476**
Disease 5	**-0.359097986**
Disease 6	**0.065272043**
Disease 7	**0.456456908**

Table IV shows the correlation value of normal leaf under different distortions and Table V shows the correlation value of normal leaf in different orientations. The disease affected leaves alone shows large difference in that value.

5. Conclusion

It can be concluded that a general robust recognition system is essential to identify images and this method shows that 100% recognition rate to identify the images was achieved. There are future possibilities for improving the performance of this image identifying algorithm if the test images are captured with high distortions. The same proposed algorithm can be extended in application to find the diseases in leaves to calculate the affected area, intensity of the disease to find whether the pesticides are required in the field or not.

TABLE IV
Correlation value of same leaf with different Distortions

LEAF WITH DIFFERENT DISTORTIONS	CORRELATION VALUE
ROTATION 30^0	**0.99916211**
SIZE REDUCTION	**0.999721586**
SIZE ENLARGEMENT	**1**
SHARPENING MORE	**0.999995497**
DUST AND SCRATCH	**1**

TABLE V
Correlation value of same leaf with different Orientations

SAME LEAF WITH DIFFERENT ORIENTATIONS	CORRELATION W.R.T NORMAL LEAF
NORMAL ORIENTATION	1
ORIENTATION 1	0.999425695
ORIENTATION 2	0.994062743
ORIENTATION 3	0.999921616
ORIENTATION 4	0.999098604
ORIENTATION 5	0.991590139
ORIENTATION 6	0.999998381
ORIENTATION 7	0.991590139
ORIENTATION 8	0.997697578
ORIENTATION 9	0.998377463

References

[1] A. S.M. Al-Saqer, P. Weckler, J. Solie, M. Stone and A.Wayadande,” Identification of Pecan Weevils through Image Processing” American Journal of Agricultural and Biological Sciences 6 (1): 6979,2011 ISSN 1557-4989

[2] Diao zhihua,Wang Huan,Song yinmao,Wangyunpeng
“Image Segmentation method based on color features and area thresholding”, Journal of Theoretical and Applied Information Technology 10th February 2013. Vol. 48 No.1.

[3] Gonzalez, R., R. Woods and S. Eddins, 2004. “Digital Image Processing Using MATLAB”. 1st Edn., Prentice Hall,

[4] Jain A K,”Image Analysis and Computer Vision”, PHI, New Delhi, 1997

[5] Kripali S. Deshmukh, “,Disease Detection of Crops Using Hybrid Algorithm” © 2010 Science Publications International Journal of Engineering Research & Technology (IJERT)Vol. 1 Issue 10, December- 2012 ISSN: 2278-0181

[6] Sabah Bashir, Navdeep Sharma “Remote Area Plant Disease Detection Using Image Processing “IOSR Journal of Electronics and Communication Engineering (IOSRJECE) ISSN : 2278-2834 Volume 2, Issue 6 (Sep-Oct 2012), PP 31- 34

[7] J. K. Sainis R. Rastogi, and V. K. Chadda,” Applications of image processing in Biology and agriculture”
International Journal of Computer Applications(0975-8887) Volume 52-No.2, August 2012

[8] Amandeep Mavi, Mandeep Kaur “Identify Defects in Gears Using Digital Image Processing” International Journal of Engineering Research and Development ISSN: 2278-067X, Volume 1, Issue 6 (June 2012), PP.49-55