Automatic Logo Based Document Verification Using GLCM & ANN

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ABSTRACT
Document verification is important task which is done in various government department & organization, like register office, school, college, University, government departments, business documents etc. The main purpose of document verification is to identify the reality and originality of the document submitted by the candidate towards the organization for different purpose like getting admission or Job. Now days some of the duplicate documents have been submitted by the candidate for admission purpose or job purpose, such documents should be properly sorted depending on logo base and such document should be send towards that specific university for further verification. The document is automatically classified by organization wise for further simplification. Manually document verification is very difficult task. Proposed model helps for automatic logo based document verification. This paper disuses the method of logo detection and logo verification for this purpose feature that has been extracted using GLCM. Which gives us 22 features of each image and the Neural Network classifier is used to automatic document classification; it gives 95% recognition rate.

Keywords *- Gaussian filter, GLCM (gray level co-occurrence), LM (Levenberg-Marquardt) algorithm, Logo, NN (Neural Network), TC (Transfer Certificate).*

I. INTRODUCTION

Every organization has their unique identity for their work which is represented by a graphical symbol called as Logo. Such logos are used in different document by the organization. In case of school and colleges also logos are used on documents like TC, degree certificate etc. in day-to-day life such TC and degree certificate or marks memos are used for further education or for getting the job in organization. When these documents are submitted to the organization then it should be verified properly. Because in some cases some of the candidates submit the duplicate documents to organization for getting job or admission. The employer can identify the document on basis of logo, but huge documents cannot be identified by the human in less time. Presented papers discuss a system that identifies the document on logo basis. Following steps are used in this system.

1) Input the document image by scanner or any camera.
2) Converts the RGB image into gray scale.
3) Segment the logo from document image.
4) Apply the GLCM algorithm to extract the feature of logo
5) Classify the document using neural network.

In this case the organizations are the employers have to take precaution of the originality of the document. Presented paper gives the direction regarding of automatic document verification, due to which the originality can be recognized & organization will give the admission without hesitation.

This paper uses GLCM method in which LM algorithm is used for feature extraction although this method and algorithm is used by some authors like Sushila Shidnal, who work on texture feature extraction using GLCM. In this work 6 varieties of crop images are considered namely paddy, maize, cotton, groundnut, sugarcane and sunflower. They got 63.75% result [1]. Gowri Ariputhiran, works on satellite image using Gaussian filter, GLCM and BPANN (Back Propagation Artificial Neural Network) they got 94.59% result [2].

Shridevi Soma, B.V Dhandra worked on Logo segmentation, Feature Extraction and Matching techniques. They used scanned images with 300dpi and they got 96.34% accuracy rate [3]. Though this system obtained higher recognition rate then also they are working on only scanned images. For more realistic system presented paper uses images from scanner as well as camera with specification 464 X 456 image dimension, 96 dpi with 24 bit depth.

Umesh D. Dixit 1 and M. S. Shirdhonkar 2, working on automatic logo extraction from document image that is work with only scanner [4].
Nishanth.T.R ,Jemimah Simon, worked on novel solution for logo matching and recognition based on Context-Dependent Similarity (CDS) kernel [5].
Junhee Youn1) · Gi Hong Kim2) · Kyusoo Chong3), they work on least squares matching (LSM) algorithm is applied to the corner points to extract direction information. For the LSM algorithm, eight directional arrow head shape templates are used. As a result, we can automatically extract direction information from road sign imagery [6].
Wei-Shi Zheng, Member, IEEE, Shaogang Gong, and Tao Xiang, they work on new maximum margin context (MMC) model to evaluate and measure the usefulness of contextual information directly and explicitly through a discriminant context inference method [7]
Sung Ju Hwang, Student Member, IEEE, and Kristen Grauman, Member, IEEE, leverage "unspoken" cues that rest within an ordered list of image tags so as to improve object localization [8].
Mohamed Ben Salah, Ismail Ben Ayed, Member, IEEE, and Amar Mitiche, Member, IEEE Computer Society, they work on corresponding curve evolution equation can be viewed as a geodesic active contour (GAC) flow having a variable stopping function which depends on the feature distribution on the active curve [9].
Ms. Girja Sahu, Mr. Lalitkumar P. Bhaiya they worked MRI Images through GLCM algorithm [10].
M.Harsha vardhan, S.Visweswara Rao, as per his opinion most common way is using a Gray Level Co-occurrence Matrix (GLCM). GLCM contains the second-order statistical information of neighboring pixels of an image [11].
The main purpose of proposed work is to extract feature of logo. Then classify the document with organization by using GLCM and NN classifiers.
Next step of this study is to extend this system to implement its application in access confidential document like stamp, signature, UID number present on documents, government certificates etc.

II. PROPOSED METHODOLOGY

The proposed method consists of four different steps, including the logo collection through different input devices like camera/scanner which uses different mega pixel images. The reason behind this is; system should perform the best whenever image is given as input it may have different resolution and specification. Following diagram depicts the process flow used in this system.

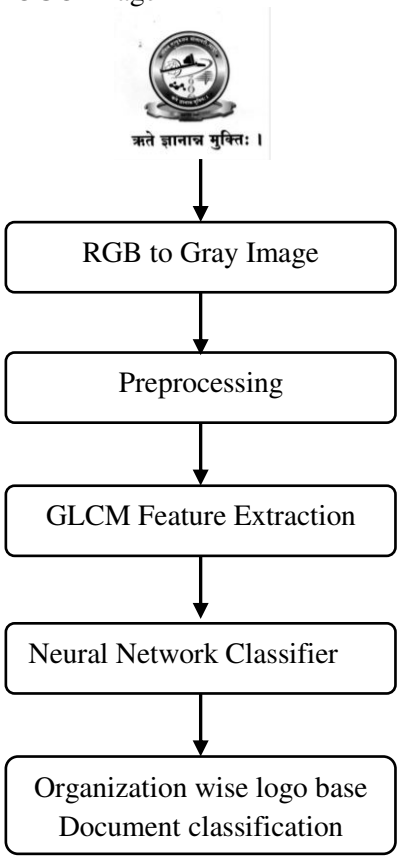


Fig 1 working model of Proposed Systems
Working model of proposed system consists of a) image acquisition, b) Image conversion, c) preprocessing, d) feature extraction, e) classification.

A. Image acquisition

Automatic document image processing is challenging task. This paper uses its own database for automatic document verification generated by visiting some organization and capture document images by scanner or different mobile with different resolution. Following table gives the details of database.
For logo based automatic document verification total 100 images are used. These logos taken from 10 different organizations. From each organization 10 samples of logos are collected. For this model 20 logo samples have been selected from database. Each logo sample having specifications like 464 x 456 dimensions, 96 dpi gray scale images.

B. Image conversion

The common processing while working on images should be performing transfer RGB into gray scale

image. Because the result is very good when we work on gray scale image & friendly feature can be extracted.

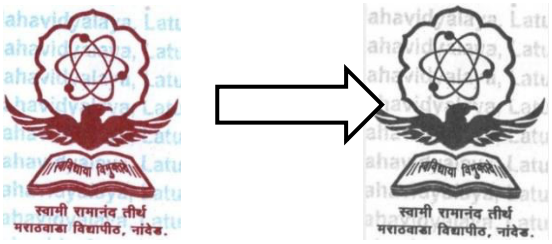


Fig: 2 RGB Image is converted into Gray Scale Image

When images are captured they are 24bit depth color images. For getting quality images, all color images are converted into gray scale which obtains better features when applied GLCM.

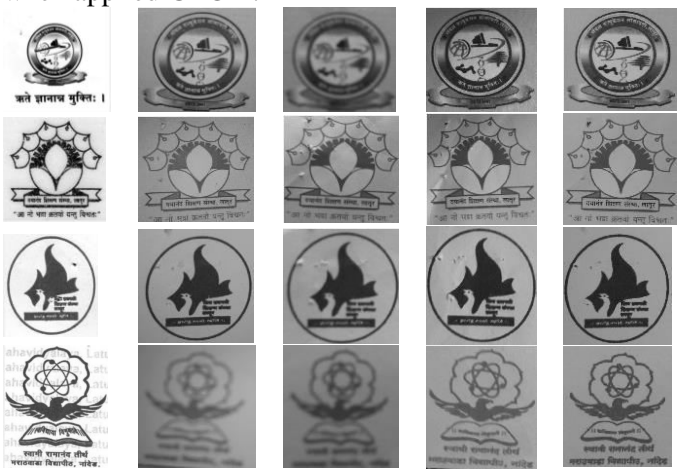


Fig: 3 logo images from different organization.

C. Preprocessing

Document identification should perform preprocessing because the image taken by scanner or camera having noises on image. It should be removed for extraction of quality feature. So the Gaussian filter is used to remove noises from logo images.

$$G(x,y)=\frac{1}{2\pi\sigma^2}e^{\frac{x^2+y^2}{2\sigma^2}} \quad (1)$$

D. Features Extraction

Feature extraction is important step in automatic logo detection to obtain the most relevant information from the original data and represent that information in a lower dimensionality space. For feature extraction GLCM is used in this model.
In this method G is gray level matrix P is represented by μ means Px and Py is represented by μx, μy, σx and σy it will be displayed by P(i,j).

$$\mu_y(j)=\sum_{j=0}^{G-1}(j) \quad (2)$$

$$\sigma_x^2=\sum_{i=0}^{G-1}P_x(i)-\mu(i))^2 \quad (3)$$

$$\sigma_y^2=\sum_{j=0}^{G-1}P_y(j)-\mu(j))^2 \quad (4)$$

These equations are used for to extract the feature from different logo store it into input vector and these feature are passed to NN tool for the classification.

$$IDM=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}\frac{1}{1+(i-j)^2}P(i,j) \quad (5)$$

Inverse Difference Moment (IDM) when image is gray the GLCM inverse is high.

$$ASM=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}\{P(i,j)\}^2 \quad (6)$$

Where i,j is coordinate of p(i,j)

Angular Second Moment is also known as Consistency or Energy. ASM is sum of squares in GLCM. This is very high when image is good or pixel is very similar.

$$Entropy=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}P(i,j)\times\log(P(i,j)) \quad (7)$$

Entropy is used for statistical measure of randomness of image this used 2 bins for logical image and 256 bins for unit16 image. If we pass RGB image it is treated as gray scale image [12].

$$Contrast=\sum_{n=0}^{G-1}n^2\{\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}P(i,j)\},|i,j|=n \quad (8)$$

$$\text{Correlation}=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}\frac{\{i\times j\}\times P(i,j)-\{\mu x\times\mu y\}}{\sigma x\times\sigma y} \quad (9)$$

It is used to measures neighboring pixel of gray scale image.

$$\text{Variance=Variance}=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}x(i-\mu)^2P(i,j) \quad (10)$$

$$Inertia=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}x(i-j)^2P(i,j) \quad (11)$$

$$Clustershade=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}(i+j-\mu x-\mu y)^3P(i,j) \quad (12)$$

$$Cluster\ \text{Pr}o\min ence=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}(i+j-\mu x-\mu y)^4P(i,j) \quad (13)$$

Max probability=max(max(matrix)) (14)

$$Sumaverage=\sum_{i=0}^{2G-2}iP_{x+y}(i) \quad (15)$$

$$SumEntropy = \sum_{i=0}^{2G-2} i\, P_{x+y}(i) \log P_{x+y}(i) \quad (16)$$

$$Difference\,Entropy = \sum_{i=0}^{G-2} i\, P_{x+y}(i) \log P_{x+y}(i) \quad (17)$$

By using GLCM 22, features are extracted from each logo sample. The main purpose of feature extraction is to classify different document of different organization for logo base retrieval. Following table shows some feature of logos extracted by using GLCM. As the GLCM includes different algorithms like Contrast, Correlation, Entropy, Autocorrelation, and Homogeneity. Values obtained from these different algorithms are different so this is a clue to make the difference between two different logos.

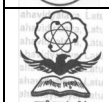
Input Image	Contrast	Correlation	Entropy	Autocorrelation	Homogeneity
	0.863	0.904	1.502	52.571	0.915
	1.125	0.881	2.595	42.424	0.808
	0.547	0.936	1.536	48.429	0.903
	0.898	0.884	1.929	48.226	0.850

Table 1: Extracted feature of different Images

Following figure show 20 features on each logo.

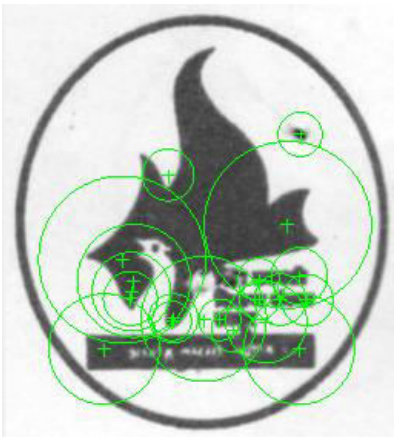


Fig: 4. Feature present on each image.

E. Classification

Extracted feature are passed to Neural Network for the classification purpose. For classification LM algorithm, feed forward neural network is used. 22 input layers are provided to the neural network these 22 inputs should be classify in 4 output layer. 10 hidden neurons are used for the process. They are called intermediate layer. The

hidden layer is used for the classification. Each and every node of output layer takes the input from hidden layer. Following diagram represent Neural Network used for classification.

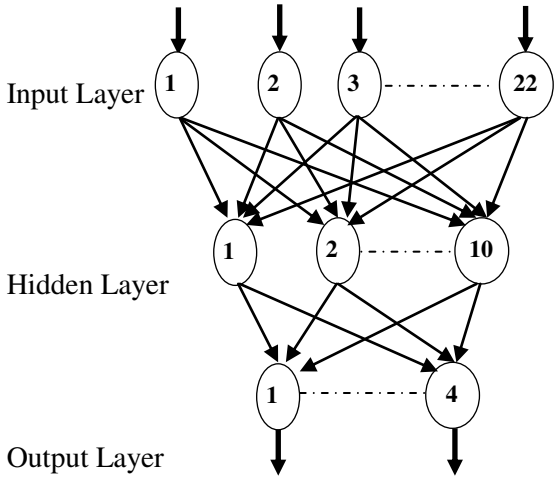


Fig: 5 Neural Network for classification of images.

III. RESULT

From each logo image 22 features are extracted. For experiment total 20 images have been selected. So total 440 features are obtained for the experiment. These 440 features are passed NN for classification and we obtain 95% recognition rate.

Logo	No of Classification Images	No of Miss Classification Images	Accuracy (%)
logo1	5	Nil	100
logo2	5	Nill	83
logo3	5	Nil	100
logo4	4	1	100

Table 2: Performance Measure of LM algorithm is given below.

From above table show classification of 3 types 15 logos are classified properly. But 1 image from logo 4 is misclassified.

Epochs	12
Per Training	0.2056
Per Validation	0.22437
Performance	0.2100
Per Testing	0.2446
Classification Time	0.0001
Classification Accuracy	95%

Table 3: Performance Measure of LM algorithm.

The equation for calculation of MSE.

$$MSE = \frac{\sum_{i=0}^{P}\sum_{j=0}^{N}(d_{ij} - y_{ij})^2}{NP} \quad (18)$$

Where p is number of output element and N is number of training data set [13].

Presented methods performance is given in above table which shows in 12 epoch 95% accuracy rate obtain which took only 0.0001 times for classification with validation 0.22437 and performance rate is 0.2100.
Following figures show best validation performance of this method.

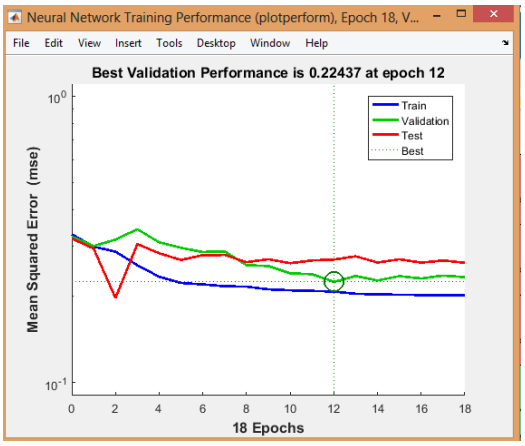


Fig: 6 Flow performance of classifier.

The confusion matrix displays the percentages of classification. 20 logo images of four different organizations are used in this experiment it displays 95% accuracy with LM algorithm. The confusion matrix shows class 1, class 2 and class 3 exactly classified. But from class 4 one image is misplaced that is overlapped with class 2 so the classification rate of class 2 is 83.3% and average error is 5%. But average classification rate is 95%.

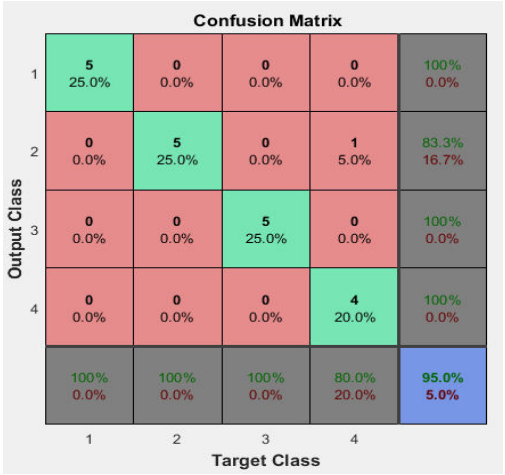


Fig: 7 Result of Confusion Matrix.

IV. CONCLUSION

The proposed work is used to extract the features of different logo which is collected by different organization for the document verification and classification. For this purpose GLCM is used for features extraction. This algorithm gives us 22 feature of each sample of logo images. 440 features are obtained from GLCM and passed to NN for classification which gives higher recognition rate that is 95% accurate classification done using LM algorithm.

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