International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST

Performance Analysis of Structure Similarity Algorithm for the Recognition of Printed Cursive English Alphabets

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Article Info
Volume 8, Issue 5
Page Number : 555-559
Publication Issue
September-October-2021
Article History
Accepted : 16 Oct 2021
Published : 30 Oct 2021

ABSTRACT

In this paper we analyse the performance of Structure Similarity algorithm for the recognition of printed cursive english alphabets, SSIM is a structural method suitable for printed characters but not efficient for cursive handwriiten characters.

Keywords : SSIM, Structure Similarity algorithm, printed characters

I. INTRODUCTION

Zhou Wang and Al Bovik developed the predecessor of SSIM in 2001. It's also called Wang–Bovik Index or Universal Quality Index (UQI) . This evolved, through their group effort with Hamid Sheikh and Eero Simoncelli, into the current version of SSIM, which was published in April 2004 in the IEEE Transactions on Image Processing.. In addition to defining the SSIM quality index, the paper provides a general context for evaluating and developing perceptual quality measures, including direct validation of the index against human subject ratings and connections to human visual neurobiology and perception.

SSIM was rapidly adopted by the image processing community, in part because the March 2000 FRTV Phase I report by the Video Quality Experts Group had concluded that nine previously proposed models for perceptual quality were ineffective.

The structural similarity index (SSIM) is a technique for predicting the various kinds of digital images and videos also the perceived quality of digital television and cinematic pictures. For Image and Video Engineering(LIVE) ,the first version of the model was developed in the Laboratory at The University of Texas at Austin and further developed jointly with the Computational Vision (LCV) Laboratory at New York University.

The SSIM index is a full reference metric also it is used for measuring the similarities between two images; in other words, the measurement or prediction of image quality is based on distortion – free image or an initial uncompressed as reference. SSIM is designed to improve on traditional methods

such as mean squared error(MSE) as well as peak signal-to-noise ratio (PSNR).

By the Help of MATLAB

PSNR=20*log(255/std2(abs(j-i(:,:,1))));

This is the formula from where we can judge whether the image quality is improved or not after process out MSSIM (measurement of Structure similarity) must be near to one.

II. MATHEMATICAL EXPRESSIONS

Peak signal-to-noise ratio (PSNR) and Mean Squared Error (MSE)

PSNR is a abbreviation for peak signal-to-noise ratio, is an engineering term for the ratio between the maximum possible power of a signal and the (or codec type) and same content. It is most easily defined via the mean squared error (MSE) which for two m×n monochrome images I and K where one of the images is considered a noisy estimation of the other is defined as,

Measurement of structure similarity algorithm used for image structure analysis

$$MSE=\frac{1}{mn}\sum_{i=0}^{m-1}[I(i,j)-K(i,j)^2 \quad \text{-----(1.1)}$$

Researcher has review the improved image quality by utilizing this PSNR with the help of MSE. The expression is carried out as follows.

The PSNR has been defined for our experimental view as :

$$PSNR=10.\log_{10}\left(\frac{MAX_1^{\ 2}}{MSE}\right)$$

$$=20\log_{10}\left(\frac{MAX_1}{\sqrt{MSE}}\right) \quad \text{----(1.2)}$$

Here, MAX_I is the maximum possible image pixel value. When the pixels are represented by using 8 bits per sample, this is 255. More generally, when samples are represented using linear PCM with B bits per sample, MAXI is 2B–1. For color images with three RGB values per pixel, the meaning of PSNR is the same . The MSE is the sum over all differences of squared value divided by size of image also by three. Typical values for the PSNR in lossy image and video compression are between 30 to 50 dB, where higher is better. The MSE will be zero when the two images are identical ,resulting in an infinite PSNR.

III.STANDARD DATABASE CREATED FOR CURSIVE ENGLISH ALPHABETS

We have created standard database for cursive English alphabets which includes alphabets of cursive English as shown in table 1.1. Each character image is a PNG image of size 50x50.

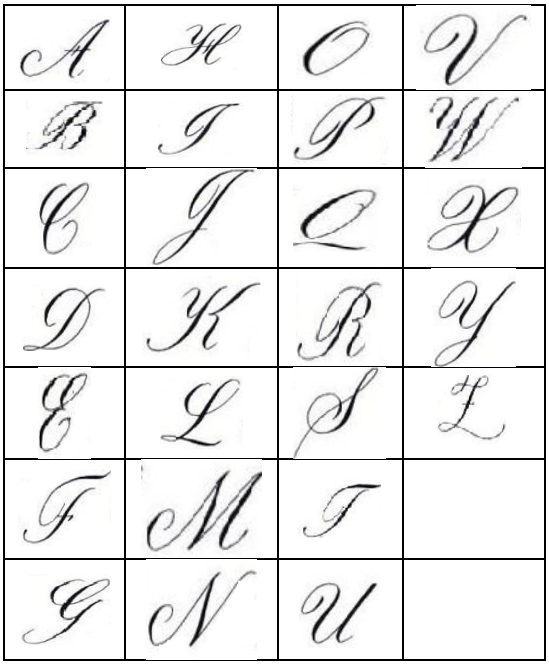


Table 1.1 Standard Database for Cursive English Alphabets

IV. EXPERIMENTAL WORK

Using MATLAB image processing tool, the matrices of each letter of the alphabets of the Cursive English are created along with the network structure. Pull the binary input code from the matrix and interpret the binary output code. To test the effect of Cursive English alphabets on character recognition, Printed Cursive English alphabets samples were scanned and it had been converted to the vectors. Each character image is converted to a MATLAB vector. Letters from

the sentence written in Cursive English alphabets were used to create the test set to determine the structure similarity between standard sample of alphabets of Cursive English alphabets and corresponding printed characters.

In this experiment we had taken standard images of the Cursive English alphabets with which the 100 samples of printed Cursive English alphabets are compared. SSIM function generates the accuracy results as shown in the table 1.2.

Our goal is to provide the noise free image near to original image it has been checked by MSSIM (Measurement of Structure Similarity Algorithm) as the MSSIM values increases the noise decrease so MSSIM and Noise value are running inversely proportional.

We applied our scheme on selected images out of 104 English cursive character images obtained from different individuals. The data set was containing varieties of writing styles.

Following are the steps to follow in this experimental work:

I) Data collection in the form of printed characters.

II) Collection of data also includes some scanned data taken from old document.

III) Hence, noise was removed & tried to clarify at most pure letter, for this some image processing technique are used like High pass filter and Gaussian filter.

IV) After this, we applied SSIM algorithm to classify the letters from each other.

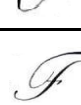
V) Most of the image processing tools and classification work has been carried out by using MATLAB 7.8 software.

VI) Input image to the system is binary image of 50 X 50 sizes.

V. EXPERIMENTAL WORK

TABLE I

FONT SIZES FOR PAPERS

S. No.	Character	Std. Characters	Measured Structure Similarity				
			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	A		0.9759	0.9801	0.9770	0.9800	0.9756
2	B		0.9806	0.9806	0.9834	0.9856	0.9833
3	C		0.9766	0.9743	0.9812	0.9788	0.9765
4	D		0.9811	0.9813	0.9806	0.9845	0.9800
5	E		0.9771	0.9743	0.9722	0.9744	0.9712
6	F		0.9759	0.9759	0.9759	0.9759	0.9765
7	G		0.9723	0.9812	0.9745	0.9806	0.9788
8	H		0.9812	0.9806	0.9712	0.9766	0.9733
9	I		0.9806	0.9722	0.9743	0.9722	0.9766
10	J		0.9722	0.9806	0.9771	0.9743	0.9759
11	K		0.9822	0.9856	0.9834	0.9867	0.9877
12	L		0.9764	0.9778	0.9812	0.9873	0.9822
13	M		0.9723	0.9756	0.9788	0.9866	0.9811
S. No.	Character	Std. Characters	Measured Structure Similarity				
			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
14	N		0.9767	0.9812	0.9775	0.9810	0.9776

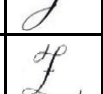
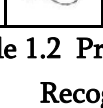
15	O		0.98 34	0.98 56	0.98 22	0.98 77	0.98 43
16	P		0.97 34	0.97 55	0.98 22	0.97 45	0.97 25
17	Q		0.98 44	0.98 43	0.98 16	0.98 15	0.98 31
18	R		0.97 21	0.97 23	0.97 22	0.97 54	0.97 62
19	S		0.97 88	0.97 67	0.97 87	0.97 45	0.97 63
20	T		0.98 77	0.98 67	0.98 55	0.98 33	0.98 44
21	U		0.98 34	0.98 56	0.98 22	0.98 77	0.98 43
22	V		0.97 34	0.97 55	0.98 22	0.97 45	0.97 25
23	W		0.98 44	0.98 43	0.98 16	0.98 15	0.98 31
24	X		0.97 21	0.97 23	0.97 22	0.97 54	0.97 62
25	Y		0.97 88	0.97 67	0.97 87	0.97 45	0.97 63
26	Z		0.98 77	0.98 67	0.98 55	0.98 33	0.98 44

Table 1.2 Printed Cursive English Alphabets Recognition Accuracy

As shown in the table 1.2 total 100 Cursive English alphabets were randomly selected by using simple random sampling method (lottery method), total 20 standard characters were compared with corresponding printed Cursive English alphabets of 5 samples. Each 5 samples of characters A-Z are compared with standard characters from standard data set of Cursive English alphabets.

VI. DISCUSSION

In this experimental work, an attempt is made to apply measured structure similarity approach to off-line recognition of printed Cursive English alphabets. Maximum performance rate of SSIM was found to up to 98 percent which is most promising than other methods. But for most of the Cursive English alphabets, structure similarity is below 50 percent. These results suggest applying image enhancement techniques to remove the noise from the images of Cursive English alphabets and reapply structure similarity algorithm to check percentage of structure similarity between standard Cursive English alphabets and sample printed Cursive English alphabets.

VII. RESULT ANALYSIS AND CONCLUSION

In this experimental work, an attempt is made to apply measured structure similarity approach to off-line recognition of printed Cursive English Alphabets. Total 100 samples were tested using SSIM. The performance rate of SSIM was found to up to 98 percent which is most promising than other existing methods. Chaudhari [1997]
reported success rate up to 95% using zonal & structural feature extraction techniques used for printed devnagari characters.
It is observed that if SSIM index value is below 0.5 then we need to apply image enhancement techniques.
We had implemented following image enhancement techniques.

1. Removed noise and background from threshold image. We obtained highly acceptable results.
2. High pass filter to increase contrast of character and to illuminate background noise. We have used imadjust() - Results are quite acceptable.
3. Gaussian filter – Results are not acceptable for most of the noisy character image.

It is necessary to apply image enhancement techniques before classifying printed Cursive English Alphabets.

SSIM is best suitable for the recognition of printed Cursive English Alphabets. It is not efficient algorithm to recognize Cursive English Alphabets since cursive alphabets which includes skew angles, morphological characteristics and invariant moments.

VIII. ACKNOWLEDGEMENT

My deepest gratitude is to my supervisors Dr. Girish S. Katkar, Head, Department of Computer Science, Taywade College, Koradi, Dist. Nagpur. I have been amazing fortunate to have an advisor who gave me dynamic supervision, time, ideas and the freedom to explore . The guidance to recover when my steps faltered. He help me to overcome many crisis situations and finish this thesis.

It is an honour for me to thank Dr. P.K. Butey, HoD, Department of Computer Science, Kamla Nehru College, Nagpur , for maintaining an atmosphere conducive to reach . It is indeed a great pleasure to express my indebtedness to Dr. Babanrao B. Taywade, President of Taywade College, Nagpur and Dr. Mrs.Sarayou B.Taywade, Principal of Taywade College, Koradi, for their kind co-operation during the course of my studies.

I would like to thanks to all the lecturers. Staff and research scholar of the Department of Computer Science and all the lecturers and staff of Taywade College, Koradi , Dist. Nagpur. For their kind co-operation, moral support and warm encouragement during the course of my study.

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Cite this article as :

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