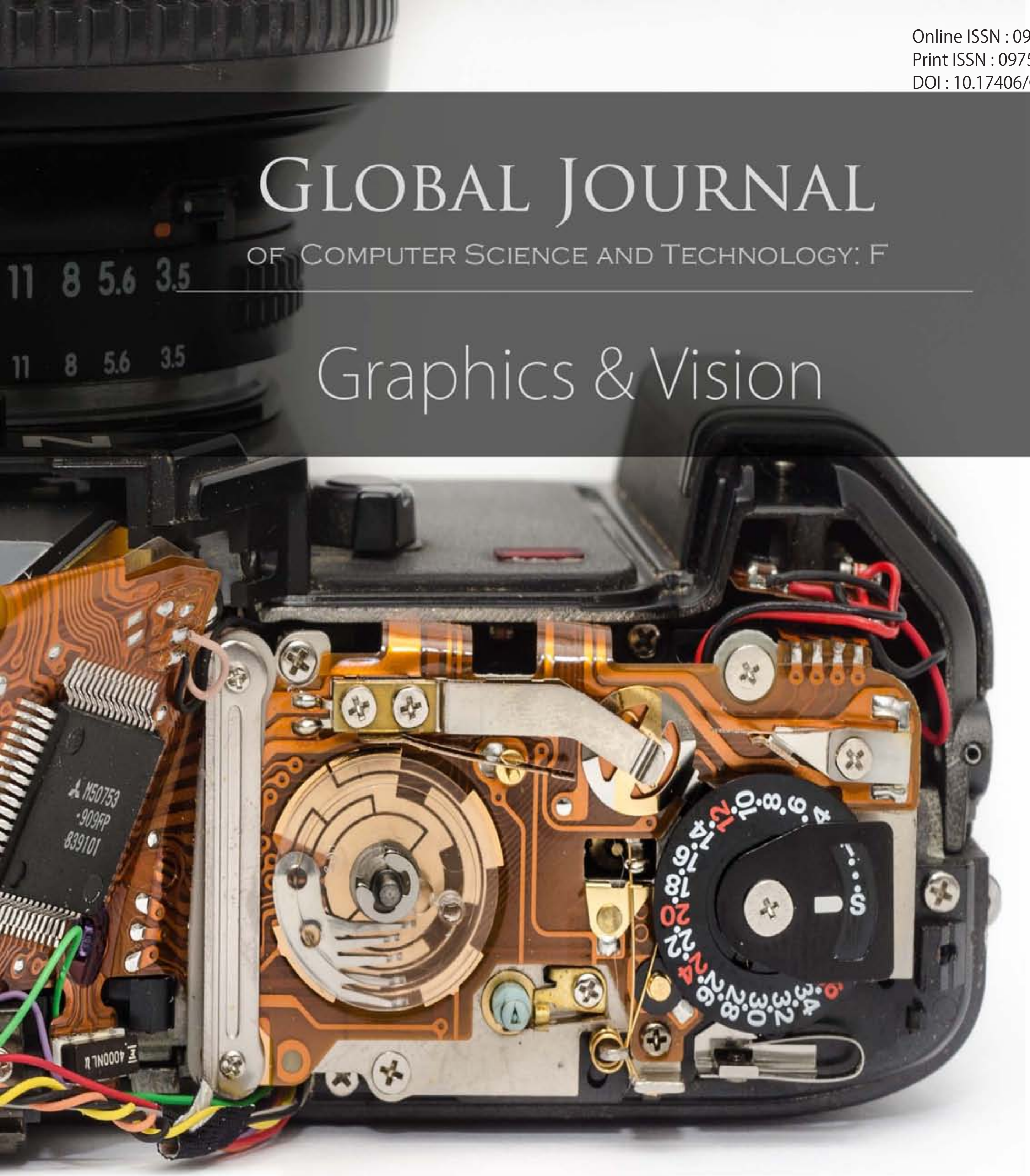
Online ISSN : 0975-4172
Print ISSN : 0975-4350
DOI : 10.17406/GJCST

Global Journal of Computer Science and Technology: F

Graphics & Vision



Highlights

- An Ambigramic Image File Format
- Mammogram Image Segmentation
- The Impact of Different Image
- Computer Generation of Fractals

Discovering Thoughts, Inventing Future

VOLUME 21 ISSUE 1 VERSION 1.0

Global Journal of Computer Science and Technology: F
Graphics & Vision

Global Journal of Computer Science and Technology: F
Graphics & Vision

Volume 21 Issue 1 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: *Open Association of Research Society*
Open Scientific Standards

Publisher's Headquarters office

Global Journals® Headquarters
945th Concord Streets,
Framingham Massachusetts Pin: 01701,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals Pvt Ltd
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Excluding Air Parcel Charges):

Yearly Subscription (Personal & Institutional)
250 USD (B/W) & 350 USD (Color)

Editorial Board

Global Journal of Computer Science and Technology

Contents of the Issue

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 21 Issue 1 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

An Ambigramic Image File Format

By Wenyi Cui, Kohei Inoue & Kenji Hara
Kyushu University

Abstract- We propose an image file format that can be read in two ways, where two images are recorded in a single file as a bit sequence, and the forward reading the bit sequence makes one of the two images visible, or the backward reading makes another image visible. Such a way of looking at a binary data in two ways resembles that of an ambigram, which is a piece of calligraphy that can be read in two ways by rotating it or introducing other perspectives. The proposed ambigramic image file format is compared with the graphics interchange format (GIF) experimentally, and the results show the better quality of the ambigramic images than that of GIF images.

Keywords: ambigram, image file format, error diffusion, integral image-based signal-to-noise ratio (ISNR).

GJCST-F Classification: I.3.3

ANAMBIGRAMICIMAGEFILEFORMAT

An Ambigramic Image File Format

Wenyi Cui [α], Kohei Inoue [σ] & Kenji Hara [ρ]

Abstract- We propose an image file format that can be read in two ways, where two images are recorded in a single file as a bit sequence, and the forward reading the bit sequence makes one of the two images visible, or the backward reading makes another image visible. Such a way of looking at a binary data in two ways resembles that of an ambigram, which is a piece of calligraphy that can be read in two ways by rotating it or introducing other perspectives. The proposed ambigramic image file format is compared with the graphics interchange format (GIF) experimentally, and the results show the better quality of the ambigramic images than that of GIF images.

Keywords: ambigram, image file format, error diffusion, integral image-based signal-to-noise ratio (ISNR).

I. Introduction

Ambigram is a typographical design that can be read in multiple orientations as shown in Fig. 1, where a word 'ambigram' is written in a rotationally symmetric manner. There are other types of ambigrams such as mirror, perceptual shift and 3D ambigrams [1]. Langdon [2], [3] has made a lot of interesting ambigrams for a long time. Those ambigramic artworks give pleasure to the viewers, and provide great inspiration for artists and engineers.

Figure 1: Example of ambigram

Inspired by such successful ambigrams, in this paper we suggest an application of the idea of ambigram to an ambigramic interpretation of a bit sequence. In other words, we propose a method for describing two images with a bit sequence, which is a digital ambigram that can be seen as one of the two images if the bit sequence is read forward direction, or as another image if the bit sequence is read backward direction. The proposed ambigramic images are compared with the graphics interchange format (GIF) images [4], and the effectiveness of the proposed method is demonstrated in the experiments using natural images, where an image quality measure is used for evaluating the quality of halftone images including palette-based images such as GIF images.

The rest of this paper is organized as follows: Section 2 describes the proposed algorithm for generating ambigramic bit sequences. Section 3 shows experimental results. Finally, Section 4 concludes this paper.

II. Proposed Ambigramic Image Data Structure

In this section, we propose a method for formatting image data into an ambigramic data structure, which is recorded in a binary file. Assume that two images are given as an input data as $A = [a_{ij}]$ and $B = [b_{ij}]$, where a_{ij} and b_{ij} denote color vectors at the pixel position $(i; j)$ in the images A and B, respectively, for $i = 1; 2; : : : ;m$ and $j = 1; 2; : : : ; n$, i.e., A and B are the same size. Then we attempt to store A and B in a storage as a single file. Figure 2 illustrates the situation, where A and B are represented by a bit sequence, and stored in some place of a storage. If we read the bit sequence from left to right, then we see the image A. On the other hand, if we read it from right to left, then we see the image B. The procedure for constructing such a bit sequence from A and B is described as follows.

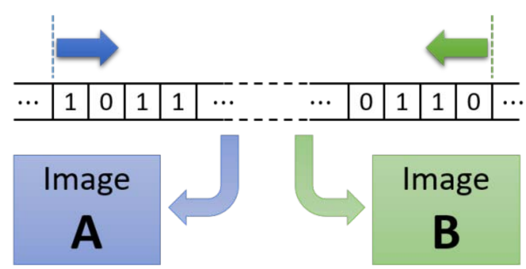


Figure 2: Illustration of an ambigramic bit sequence

Let us consider a typical case that aij and bij are 24-bit RGB color vectors as $a_{ij} = [r_{ij}^A, g_{ij}^A, b_{ij}^A]$ and $b_{ij} = [r_{ij}^B, g_{ij}^B, b_{ij}^B]$, each element of which is represented by 8 bits. Here, we introduce a binary representation of r_{ij}^A as $(r_{ij1}^A\, r_{ij2}^A\, r_{ij3}^A\, r_{ij4}^A \,|\, r_{ij5}^A\, r_{ij6}^A\, r_{ij7}^A\, r_{ij8}^A)_2$, where the third subscript in each element ranging from 1 to 8 indicates the significance of each digit, i.e., r_{ij1}^A denotes the most significant bit (MSB), and r_{ij8}^A denotes the least significant bit (LSB) in this binary representation. Other elements in a_{ij} and b_{ij} are also represented in binary in the same manner as r_{ij}^A. Moreover, we abbreviate a series of four bits $r_{ij1}^A\, r_{ij2}^A\, r_{ij3}^A\, r_{ij4}^A$ to $r_{ij1:4}^A$ for the sake of simplicity.

Author α σ ρ: Department of Communication Design Science, Kyushu University, 4-9-1, Shiobaru, Minami-ku, Fukuoka, 815-8540 Japan.
e-mails: cuiwenyi1996@outlook.com,
{k-inoue, hara}@design.kyushu-u.ac.jp

Our basic principle is to preserve more significant bits of the original image data in the resultant ambigramic image file. Following this principle, we first extract four MSBs from both A and B as follows:

$$r^A_{1,1,1:4}, g^A_{1,1,1:4}, b^A_{1,1,1:4};\ r^A_{1,2,1:4}, g^A_{1,2,1:4}, b^A_{1,2,1:4}; \cdots \cdots; r^A_{m,n,1:4}, g^A_{m,n,1:4}, b^A_{m,n,1:4} \tag{1}$$

$$r^B_{1,1,1:4}, g^B_{1,1,1:4}, b^B_{1,1,1:4};\ r^B_{1,2,1:4}, g^B_{1,2,1:4}, b^B_{1,2,1:4}; \cdots \cdots;\ r^B_{m,n,1:4}, g^B_{m,n,1:4}, b^B_{m,n,1:4} \tag{2}$$

where the horizontally adjacent pixels are separated by semicolons. Next, we reverse the order of the bit sequence in (2) as follows:

$$b^B_{m,n,4:1}, g^B_{m,n,4:1}, r^B_{m,n,4:1}; \cdots \cdots;\ b^B_{1,2,4:1}, g^B_{1,2,4:1}, r^B_{1,2,4:1};\ b^B_{1,1,4:1}, g^B_{1,1,4:1}, r^B_{1,1,4:1} \tag{3}$$

where note that the third subscripts (1:4) is also reversed as (4:1), e.g., $r^B_{1,1,4:1}$ denotes $r^B_{1,1,4}\ r^B_{1,1,3}\ r^B_{1,1,2}\ r^B_{1,1,1}$. Then we combine (1) and (3) as follows:

$$(r^A_{1,1,1:4}|b^B_{m,n,4:1})_2, (g^A_{1,1,1:4}|g^B_{m,n,4:1})_2, (b^A_{1,1,1:4}|r^B_{m,n,4:1})_2; \cdots; (r^A_{m,n,1:4}|b^B_{1,1,4:1})_2, (g^A_{m,n,1:4}|g^B_{1,1,4:1})_2, (b^A_{m,n,1:4}|r^B_{1,1,4:1})_2 \tag{4}$$

which can be viewed as an ambigramic bit sequence, because if we read the bit sequence in (4) from left to right then the four MSBs in every pixel show the image A, on the other hand, if we read it from right to left then the four LSBs in every pixel are inversely read to show the image B. However, the resultant images can be corrupted by the replacement of the original four LSBs with others. To alleviate such a quality deterioration in the images, we next propose an error diffusion algorithm for generating better bit sequence, which improves the visual quality of the images.

The proposed error diffusion algorithm is described as follows. For one image A, all pixels are processed in a standard raster scan order, and at the same time, for another image B, all pixels are processed in the inverse raster scan order. For the first pixel in image A, the original color vector $a_{1,1}$ changes to

$$\tilde{\boldsymbol{a}}_{1,1} = \begin{bmatrix} (r^A_{1,1,1:4}|b^B_{m,n,4:1})_2 \\ (g^A_{1,1,1:4}|g^B_{m,n,4:1})_2 \\ (b^A_{1,1,1:4}|r^B_{m,n,4:1})_2 \end{bmatrix}. \tag{5}$$

Subtracting $\tilde{a}_{1,1}$ from $a_{1,1}$, we define an error vector by

$$\boldsymbol{e}^A_{1,1} = \boldsymbol{a}_{1,1} - \tilde{\boldsymbol{a}}_{1,1}, \tag{6}$$

which is diffused to unprocessed neighboring pixels as

$$\boldsymbol{a}_{1+k,1+l} \leftarrow \boldsymbol{a}_{1+k,1+l} + w_{k,l}\boldsymbol{e}^A_{1,1}, \tag{7}$$

Where k and l denote relative indices to access the neighboring pixels, and $w_{k,l}$ denotes error diffusion coefficients or error filter [5]. On the other hand, for the last pixel in image B, the original color vector $b_{m,n}$ changes to

$$\tilde{\boldsymbol{b}}_{m,n} = \begin{bmatrix} (r^B_{m,n,1:4}|b^A_{1,1,4:1})_2 \\ (g^B_{m,n,1:4}|g^A_{1,1,4:1})_2 \\ (b^B_{m,n,1:4}|r^A_{1,1,4:1})_2 \end{bmatrix}. \tag{8}$$

Algorithm 1 Constructing ambigramic bit sequence

procedure AMBIGRAMIC(A, B)
  $\tilde{A} \leftarrow$ zeros_like(A) where $A = [\boldsymbol{a}_{ij}]$
  $\tilde{B} \leftarrow$ zeros_like(B) where $B = [\boldsymbol{b}_{ij}]$
  $m, n, \_ \leftarrow A$.shape
  for $i \leftarrow 1$ to m **do**
    $i_R \leftarrow m + 1 - i$
    for $j \leftarrow 1$ to n **do**
      $j_R \leftarrow n + 1 - j$
      Round the elements of $\boldsymbol{a}_{ij}$ and $\boldsymbol{b}_{i_R,j_R}$ to 8-bit integers
      $\tilde{\boldsymbol{a}}_{ij} \leftarrow \begin{bmatrix} (r^A_{i,j,1:4}|b^B_{i_R,j_R,4:1})_2 \\ (g^A_{i,j,1:4}|g^B_{i_R,j_R,4:1})_2 \\ (b^A_{i,j,1:4}|r^B_{i_R,j_R,4:1})_2 \end{bmatrix}$
      $\tilde{\boldsymbol{b}}_{i_R,j_R} \leftarrow \begin{bmatrix} (r^B_{i_R,j_R,1:4}|b^A_{i,j,4:1})_2 \\ (g^B_{i_R,j_R,1:4}|g^A_{i,j,4:1})_2 \\ (b^B_{i_R,j_R,1:4}|r^A_{i,j,4:1})_2 \end{bmatrix}$
      $\boldsymbol{e}^A_{ij} \leftarrow \boldsymbol{a}_{ij} - \tilde{\boldsymbol{a}}_{ij}$
      $\boldsymbol{e}^B_{i_R,j_R} \leftarrow \boldsymbol{b}_{i_R,j_R} - \tilde{\boldsymbol{b}}_{i_R,j_R}$
      for $(k, l) \in KL_{ij}$ **do**
        $\boldsymbol{a}_{i+k,j+l} \leftarrow \boldsymbol{a}_{i+k,j+l} + w_{k,l}\boldsymbol{e}^A_{i,j}$
        $\boldsymbol{b}_{i_R-k,j_R-l} \leftarrow \boldsymbol{b}_{i_R-k,j_R-l} + w_{k,l}\boldsymbol{e}^B_{i_R,j_R}$
      end for
    end for
  end for
  return $\tilde{A} = [\tilde{\boldsymbol{a}}_{ij}]$ and/or $\tilde{B} = [\tilde{\boldsymbol{b}}_{i,j}]$
end procedure

Subtracting $\tilde{b}_{m,n}$ from $b_{m,n}$, we define an error vector by

$$\boldsymbol{e}^B_{m,n} = \boldsymbol{b}_{m,n} - \tilde{\boldsymbol{b}}_{m,n}, \tag{9}$$

which is diffused to unprocessed neighboring pixels as

$$\boldsymbol{b}_{m-k,n-l} \leftarrow \boldsymbol{b}_{m-k,n-l} + w_{k,l}\boldsymbol{e}^B_{m,n}, \tag{10}$$

where note that the sign of the relative indices k and l is reversed except in $w_{k,l}$ because of the inverse raster scan.

After the above error diffusion procedures in (7) and (10), we proceed to the next pixels $a_{1,2}$ and $b_{m,n-1}$, and the error diffusion procedures are repeated until the end of the scan.

The proposed error diffusion procedure is summarized in Algorithm 1, where the function 'zeros_like' returns an array of zeros being the same size as the argument array, *A*.shape is a property to get the array dimensions of *A*, and KL_{ij} denotes a set of the pair of the relative indices *k* and *l* satisfying $1 \leq i + k \leq m$ and $1 \leq j + l \leq n$.

III. Experimental Results

In this section, we demonstrate the performance of the proposed method for formatting image data into an ambigramic data structure.

First, we show an example of the proposed ambigramic image data with two images selected from the standard image database SIDBA [6]. Figures 3(a) and (b) show the two standard images from SIDBA. Assume that Figs. 3(a) and (b) are images *A* and *B*, respectively. Then Algorithm 1 returns the corresponding ambigramic images $\tilde{A} = [\tilde{a}_{ij}]$ and $\tilde{B} = [\tilde{b}_{ij}]$ as shown in Figs. 3(c) and (d), which can be saved as an ambigramic bit sequence, the forward reading of which shows Fig. 3(c), and the backford reading shows Fig. 3(d). For example, the RGB values at the top left pixel of Fig. 3(c) and at the bottom right pixel of Fig. 3(d) are shown in Fig. 4, where the top left and the bottom right pixels $\tilde{a}_{11}$ and $\tilde{b}_{mn}$ have the RGB values (232; 130; 116) and (46; 65; 23), which are also expressed as binary numbers. If we reverse the order of the bit sequences of RGB values in $\tilde{a}_{ij}$, then we have the bit sequences of BGR values in $\tilde{b}_{mn}$, and vice versa.

(a) Image *A*

(b) Image *B*

(c) $\tilde{A}$ by Alg. 1

(d) $\tilde{B}$ by Alg. 1

Figure 3: Original images (a) and (b) converted into ambigramic data (c) and (d)

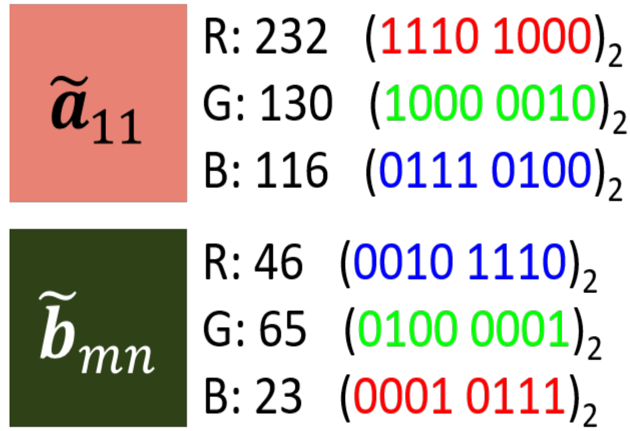


Figure 4: Comparison of pixel values

Figures 5(a) and (b) show two original images each of which has 640 × 480 pixels, and the following figures show the format-converted images from the original ones (a) and (b). Figures 5(c) and (d) show the graphics interchange format (GIF) images, and the GIF format is widely used on the Web due to its wide support and portability [4]. Figures 5 (e) and (f) show the results of the proposed ambigramic method without error diffusion (ED), where a daruma (dharma) doll and a beckoning cat can be seen as well as the above GIF images. Figures 5(g) and (h) show the results with ED (Algorithm 1), where we used Floyd and Steinberg's error filter [7] for $w_{k,l}$ in (7) and (10) as shown in Fig. 6 where "#" denotes the current pixel being processed, and "-" denotes the past pixel, and the visual quality is improved compared with the former results (e) and (f).

(a) Image A

(b) Image B

(c) GIF image A

(d) GIF image B

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

(e) $\tilde{A}$ without ED (f) $\tilde{B}$ without ED

(g) $\tilde{A}$ by Alg. 1 (h) $\tilde{B}$ by Alg. 1

Figure 5: Examples of file format conversion

The GIF images are palette-based ones each of which has a palette table of 256 colors. That is, the GIF images are a sort of halftone images [5] as well as the proposed ambigramic images. To evaluate the quality of those images objectively and quantitatively, we present a parameter-free measure based on integral image [8].

-	#	$w_{0,1} = \frac{7}{16}$
$w_{1,-1} = \frac{3}{16}$	$w_{1,0} = \frac{5}{16}$	$w_{1,1} = \frac{1}{16}$

Figure 6: Error diffusion coefficients by Floyd-Steinberg

First, we compute the integral images of both reference (original) R and test (format-converted) T images, which are denoted as $\bar{R} = [\bar{r}_{ij}]$ and $\bar{T} = [\bar{t}_{ij}]$, respectively. Then we compute the signal-to-noise ratio (SNR) [9] of the integral images $\bar{R}$ and $\bar{T}$ as follows:

$$\mathrm{ISNR}(R,T) = \mathrm{SNR}\left(\bar{R},\bar{T}\right) \tag{11}$$

$$= 10\log_{10}\frac{\sum_{i=1}^{m}\sum_{j=1}^{n}\bar{r}_{ij}^{2}}{\sum_{i=1}^{m}\sum_{j=1}^{n}\left(\bar{r}_{ij}-\bar{t}_{ij}\right)^{2}}. \tag{12}$$

We call this measure the integral image-based SNR (ISNR).

For the format-converted images in Fig. 5, their ISNRs are plotted in Fig. 7, where the vertical and horizontal axes denote the ISNR value and image name, respectively, and green, yellow and orange bars denote the file formats, GIF, ambigramic format without ED and the final ambigramic format by Algorithm 1, respectively. Algorithm 1 achieves higher ISNR values than GIF format for both images, which demonstrates the effectiveness of the proposed algorithm.

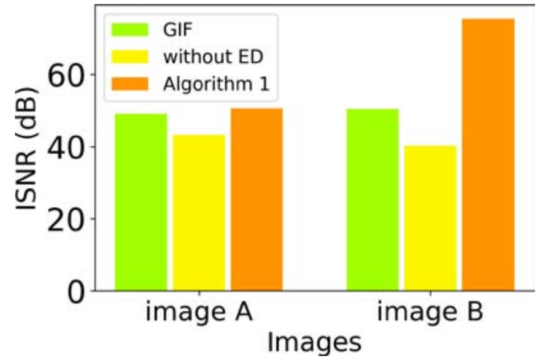


Figure 7: Integral image-based SNR (ISNR)

Additionally, we examine the applicability of the proposed algorithm to natural images shown in Fig. 8, where Fig. 8(a) shows five pairs of natural images where the top row shows the first images A, and the second row shows the corresponding second ones B. Figures 8(b), (c) and (d) show the corresponding format-converted images by GIF, the proposed ambigramic method without ED and Algorithm 1. Although, in Fig. 8(c), we can see false contours, they are removed in Fig. 8(d).

The ISNR values for those images in Fig. 8 are summarized in Table 1, where the proposed Algorithm 1 achieves higher values than the GIF images and ambigramic images without ED.

Table 1: ISNR values (dB)

	Pair 1	Pair 2	Pair 3	Pair 4	Pair 5
GIF image *A*	49.97	49.39	46.80	48.41	50.13
GIF image *B*	46.51	50.96	46.26	48.82	47.08
$\tilde{A}$ without ED	38.05	46.97	33.59	47.34	45.28
$\tilde{B}$ without ED	34.87	45.56	35.46	50.90	40.00
$\tilde{A}$ by Alg. 1	**73.93**	**60.81**	**82.48**	**95.21**	**75.76**
$\tilde{B}$ by Alg. 1	**63.61**	**88.92**	**53.09**	**94.37**	**85.13**

IV. Conclusions

In this paper, we proposed an algorithm for formatting an ambigramic image file into which two images of the same size are recorded. If we read it forward direction, then we see the first image, on the other hand, if we read it backward direction, then we see the second one. We compared the proposed ambigramic image file format with the GIF format which has acquired a widespread use on the Web, and demonstrated that the proposed ambigramic images achieved higher quality than the GIF images based on an image quality measure. Experimental results showed that the proposed algorithm is also applicable to natural images.

Acknowledgments

This work was supported by JSPS KAKENHI Grant Number JP16H03019.

References Références Referencias

1. Wikipedia, "Ambigram — Wikipedia, the free encyclopedia," https://en.wikipedia.org/wiki/ Ambigram, 2020, [Online; accessed 06-March-2020].
2. John Langdon, "Ambigrams, logos, & word art.," http://www.johnlangdon.net/, 1996, [Online; accessed 07-February-2019].
3. J. Langdon, Wordplay: The Philosophy, Art, and Science of Ambigrams, Bantam, 2005.
4. Wikipedia, "GIF — Wikipedia, the free encyclopedia," https://en.wikipedia.org/wiki/GIF, 2020, [Online; accessed 06-March-2020].
5. Daniel L. Lau and Gonzalo R. Arce, Modern Digital Halftoning, Second Edition, CRC Press, Inc., Boca Ra- ton, FL, USA, 2007.
6. M. Sakauchi, Y. Ohsawa, M. Sone, and M. Onoe, "Man- agement of the standard image database for image pro- cessing researches (sidba)," ITEJ Technical Report, vol. 8, no. 38, pp. 7–12, 1984.
7. Robert W. Floyd and Louis Steinberg, "An Adaptive Al- gorithm for Spatial Greyscale," Proceedings of the So- ciety for Information Display, vol. 17, no. 2, pp. 75–77, 1976.
8. Paul Viola and Michael Jones, "Robust real-time object detection," International Journal of Computer Vision, vol. 57, no. 2, pp. 137–154, 2002.
9. Wikipedia, "Signal-to-noise ratio — Wikipedia, the free encyclopedia," https://en.wikipedia.org/wiki/ Signal-to-noise_ratio, 2020, [Online; accessed 06-March-2020].

(a) Original images

(b) GIF images

(c) Ambigramic images without ED

(d) Ambigramic images by Algorithm 1

Figure 8: Examples with natural images

This page is intentionally left blank

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 21 Issue 1 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Ɵ (1) Time Parallel Algorithm for Finding 2D Convex Hull on a Reconfigurable Mesh Computer Architecture

By Jelloul Elmesbahi, Mohammed Khaldoun, Omar Bouattane & Ahmed Errami

Hassan II University

Abstract- In this paper we propose a parallel algorithm in image processing in Ɵ(1) time, intended for a parallel machine " Reconfigurable Mesh Computer (RMC), of size n x n Elementary Processors (PE). The algorithm consists in determining the convex envelope of a two-level 2D image with a complexity in Ɵ(1) time. The approach used is purely geometric. It is based solely on the projection of the coordinates of PEs retained in specific quadrants and on the application of the algorithm that determines the Min / Max in Ɵ (1) time.

This has reduced the complexity of the algorithm for determining the convex hull at Ɵ (1) time.

Keywords: *processional image, parallel processing, reconfigurable mesh computer, convex hull.*

GJCST-F Classification: *G.1.0*

Strictly as per the compliance and regulations of:

ϴ (1)Time Parallel Algorithm for Finding 2D Convex Hull on a Reconfigurable Mesh Computer Architecture

Jelloul Elmesbahi [α], Mohammed Khaldoun [σ], Omar Bouattane [ρ] & Ahmed Errami [Ѡ]

Abstract- In this paper we propose a parallel algorithm in image processing in **ϴ**(1) time, intended for a parallel machine " Reconfigurable Mesh Computer (RMC), of size n x n Elementary Processors (PE). The algorithm consists in determining the convex envelope of a two-level 2D image with a complexity in **ϴ**(1) time. The approach used is purely geometric. It is based solely on the projection of the coordinates of PEs retained in specific quadrants and on the application of the algorithm that determines the Min / Max in **ϴ** (1) time.

This has reduced the complexity of the algorithm for determining the convex hull at **ϴ** (1) time.

Keywords: processional image, parallel processing, reconfigurable mesh computer, convex hull.

I. Introduction

The problem of the convex envelope (convex hull) of a plane shape has been the subject of several studies in recent years. This very important problem concerns several areas such as image processing, pattern recognition or robotics [FU97]. The convex envelope can be used, for example, to normalize a shape, to triangulate a set of points, to extract topological characteristics, to decompose a complex shape in order to facilitate its recognition.

Compared to the very important number of works that have been realized on the use of sequential algorithms to extract the convex hull, the number of parallel algorithms to solve this problem is significantly lower. We have to wait until the beginning of the 80's to see the first parallel algorithms, which calculate the convex hull of a set of points [CHO81], [NAT81], [ALD83].Since then, several authors have presented parallel algorithms to solve this problem with different levels of complexity {[KIM87], [LIN93], [PRA89] and on different input data as for example on a set of points in a plane or in a space, on bi-level images, on multi-level images with a single component or several components. On the other hand, the algorithms proposed in these works, were designed for different models of machines such as the model Mesh Connected Computer [MIL85], the model Polymorphic Torus [LI89] or the model Reconfigurable Mesh Computer [HAY98].

The synthesis of these different works leads us to note that the diversity of the parameters put into play complicates any attempt at global comparison between the performances of the different approaches. Table 1 presents a synthesis of some bibliographical references on this problem by specifying each time the machine model used, the nature of the input data as well as the degree of complexity obtained.

Among the parallel algorithms for the determination of the convex hull of the connected components of a multi-level image, mention may be made of [ERR05], which describes an approach based on the structural characterization algorithm. As for the algorithm [BOU02] applies a purely geometric method. Our algorithm calculates with a complexity of ϴ (1) the convex hull of an image or set of points with two levels of gray. This algorithm uses a purely geometric approach. It is based solely on the projection of the coordinates of PEs retained in specific quadrants and on the application of the algorithm that determines the Min / Max in ϴ (1) time [ELMES91]. This allowed us to reduce the complexity of our solution compared to those proposed in the literature. The contribution of this document is summarized as follows:

- The proposed method guarantees constant time processing because all steps are executed in ϴ (1) time, while most existing algorithms are based on image processing multiple times.
- The proposed provides the convex hull not only for a set of points but also for images with two gray levels.

Author α σ Ѡ: NEST Research Group, LRI Laboratory E.N.S.E.M, Hassan II University, Casablanca, Morocco.
e-mails: j.elmesbahi@ensem.ac, aerrami@yahoo.fr, m.khaldoun@ensem.ac.ma
Author ρ: ENSET Mohammedia, Hassan II University, Morocco etc.
e-mail: o.bouattane@gmail.com

Table 1: Synthesis of some works on the problem of the extraction of the convex hull

Machine model	Nature of data	Complexity	Bibliography
Mesh connected Computer	Points Sets	θ(log n)	[MIL85]
Polymorphic Torus	Points Sets	O(1) par ensemble de points	[LI89]
hypercube	Points Sets	θ(log n) O(log n)	[MIL88] [STO88]
Pyramid	Points Sets	O(log n)	[STO88]
Pyramid tree Mesh of tree	Points Sets	θ($\log^3 n/(\log\log n)^2$)	[MIL88]
Reconfigurable Mesh	Points Sets	θ(log n)	[MIL88]
EREW PRAM	Points Sets	θ(log n)	[MIL88]
Reconfigurable Mesh	Sorted Points Sets	O(log log n)^2	[HAY98]
Reconfigurable Mesh	Bi-level image one component	O($\log^2 n$) by component	[MIL93]
Reconfigurable Mesh Computer (RMC)	Multilevel image several components	O (log n)n is the number of segments that approximate the contour of the largest component of the image.	[BOU02]
Reconfigurable Mesh Computer (RMC)	Multilevel image several components	O (log n)n represents the total number of extreme points present on the contour of the largest component of the image	[ERR05]

In this article, section 2 is devoted to the calculation model used for the implementation of the proposed algorithm. Section 3 presents the algorithm for determining the convex hull. Section 4 presents the result of determination of the convex hull of a two-level image matrix. This paper concludes with some remarks on future work.

II. Computational Model Architecture

The computational model of machine used in this paper is a parallel Reconfigurable Mesh Computer (RMC) [ELMES86] of size nxn Elementary Processors (PEs) arranged in a square matrix. It is a machine which respects the SIMD (Single instruction multiple data) model, in which each PE is located in the matrix by its row and column coordinates and can be characterized by its identifier ID = n.i + j, where i and j represent the row number and the column number respectively. In this architecture, Figure. 1 (a) refers to a set of PEs, each one is connected to its four neighbors; if they exist; through communication channels. It has a finite number of registers; of bus length log 2 (n) bits, in which it stores data to perform arithmetic and logic operations. All PEs can perform reconfiguration operations to exchange information with other PEs in the mesh. Figure1. (b) describes the set of possible configurations of each PEThe communication of each PE with its neighbors is implemented through four different operations:

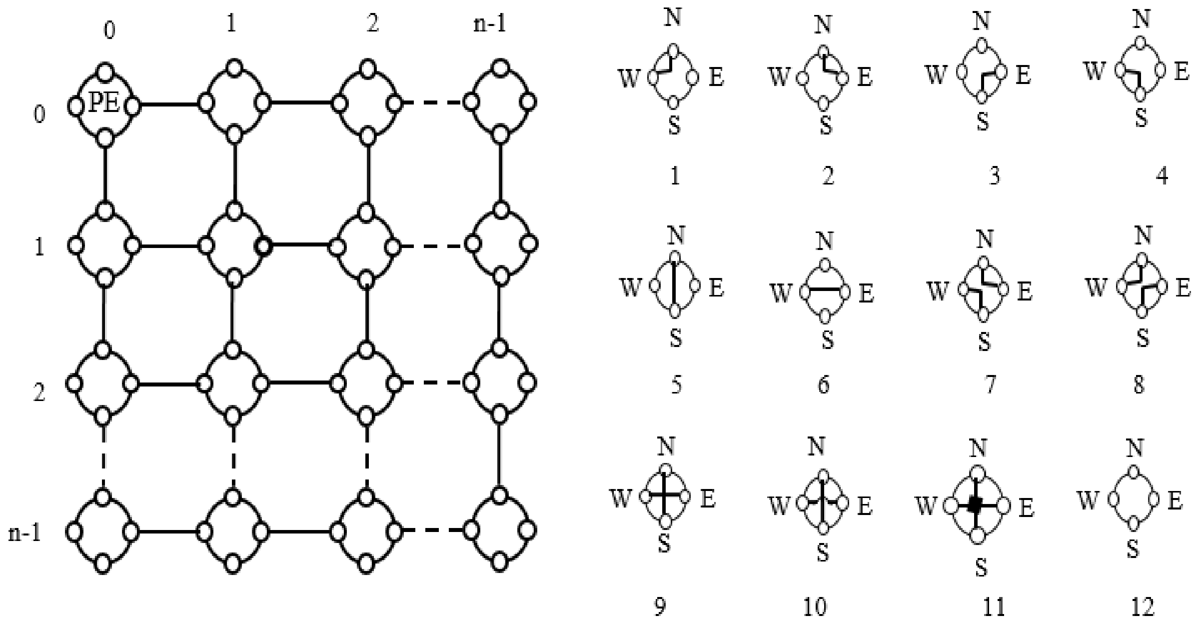
Single Bridge (SB): A PE of the RMC is in the SB state, if it establishes links between two of its communication channels, either in transmitting mode or the receiving one. In addition, it may disconnect some of its communication channels. Figure 1.b) shows the six possible configurations (1-6) of the SB configurations

Double Bridge (DB): A PE is in DB state, when it achieves configuration involving two independents buses. The configurations from 7 to 10 of Figure 1.b) shows the three possible cases of DB

Cross Bridge (CB): A PE goes to the CB state if it connects all its active communication channels into one. The figure 1 (b) shows the only possible configuration (11) with the CB operation.

Direct Broadcast: The direct broadcast operation consists in transmitting information from a transmitting PE to a set of receiving ones. The implementation of this operation is achieved as follows:

a. All PEs are in CB mode. The receiving PEs are coupled by their receiving ports. While the transmitting PEs are in the transmitting mode via their ports.
b. The transmitting PE sends the information throughout its ports. Then, all other PE receive the same information.

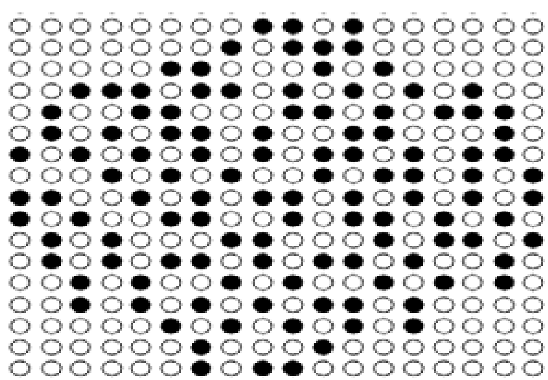


(a) (b)

Figure 1: (a) Concerned model, (b) possible configurations

III. Θ (1) Time Algorithm to Determine the Convex Hull of a Bi-level Image

Either to determine the convex hull of a set of points or PEs (Elementary Processors) arranged in the form of an image matrix as shown in Figure 2.



●Marked PE○Unmarked PE

Figure 2: Elementary Processors (PEs) arranged in the form of a set of points representing points of an image matrix.

The algorithm for determining the convex hull consists of 7 steps:

1. *Step 1:* Determination of points: i_m, i_M, j_m, j_M and points A, B, C, D, E, F, G and H (Figure 3).
2. *Step2:* Determination of points: I_1' , I_2' , I_3' et I_4' : (Figure 10).
3. Step 3: Determination of points: I_1 , I_2, I_3 et I_4 : (Figure 3).
4. *Step 4:* The delimitation of the area P_1 (quadrant: NW), then the determination of the PEs belonging to the convex hull forming part of this zone. The procedure will be applied to zones P_2, $P_3$and P_4. (Figure 3).
5. *Step 5:* Labeling of all PEs belonging to the zones P_1, P_2, $P_3$and P_4 (Figure 8).
6. Step 6: Elimination of all PEs that do not belong to the zones P_1, P_2, $P_3$and P_4. (Figure 8).
7. *Step 7:* Processing on the zones P1, P2, P3 and P4: this consists in determining PEs of the different quadrants NW, NE, SE and SW belonging to the convex envelope.

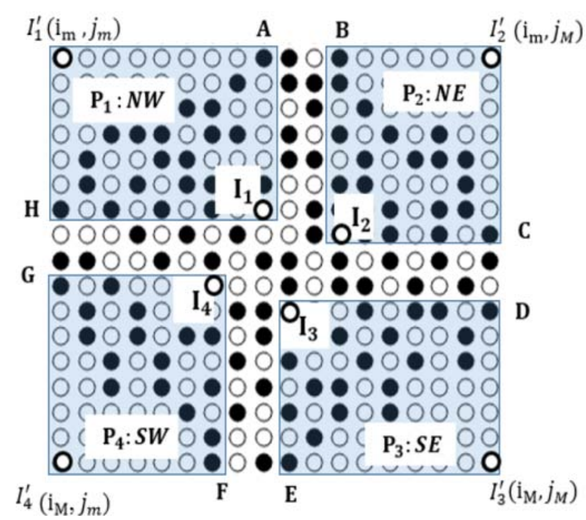


Figure 3: Step 1, Step 2 and Step 3.

Step 1:

a) All the PEs of the image matrix get into Crosse Bridge (CB) (Figure 3) and perform in Ө (1) time [ELMES91]:

1. MIN operation for lines i. (i_m is the minimum of the lines).
2. MIN operation for columns j. (j_m being the minimum of the columns).
3. MAX operation for lines i. (i_M is the maximum of the lines).
4. MAX operation for columns j. (j_M is the minimum of the columns).

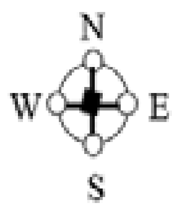


Figure 4 a: One PE in Crosse Bridge

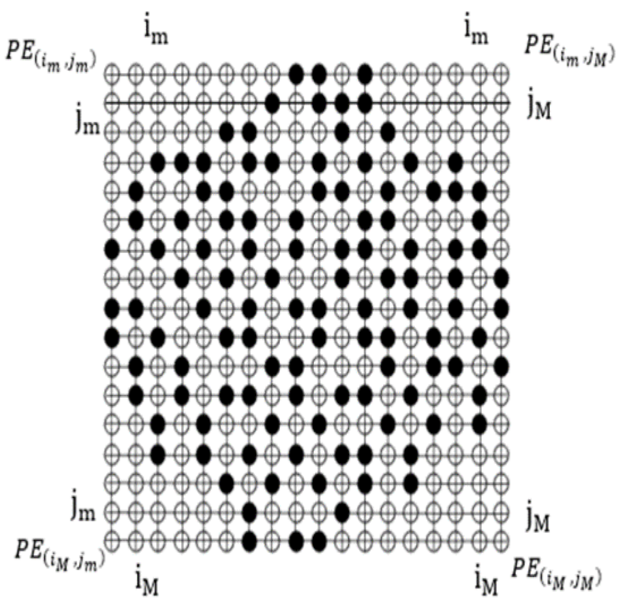


Figure 4 b: All the PEs of the image matrix in Crosse Bridge

Figure 4: Crosse Bridge

The (i_m, i_M, j_m, j_M) are all determined in Ө(1) time and the corresponding PEs are: $PE_{(i_m,j_m)}$, $PE_{(i_m,j_M)}$, $PE_{(i_M,j_m)}$, $PE_{(i_M,j_M)}$

b) All the PEs in each line go into Simple Bridge (SB) and make a MIN for the columns j then a Max for the columns j. We will have in each line at most two Marked PEs (PE_M). (Figure 5-a). For example, for the line i_m:

A = $j_{\min\_i_m}$ and $PE_A = PE_{(i_m,A)}$
B = $j_{\max\_i_m}$ and $PE_B = PE_{(i_m,B)}$
F = $j_{\min\_i_M}$ and $PE_F = PE_{(i_M,F)}$
E = $j_{\max\_i_M}$ and $PE_G = PE_{(i_M,E)}$

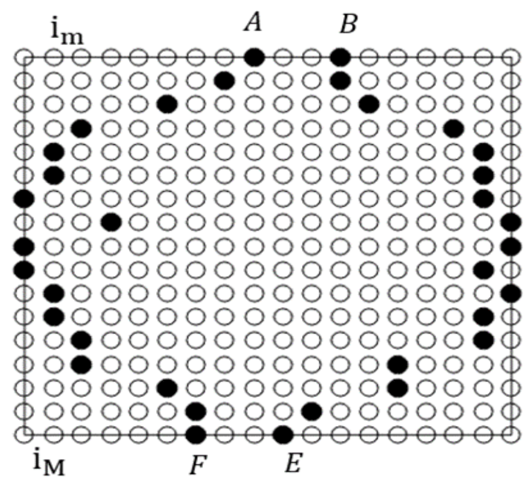


Figure 5 a: Min and Max lines

A = $j_{\min\_i_m}$,B = $j_{\max\_i_m}$
F = $j_{\min\_i_M}$,E = $j_{\max\_i_M}$

a) All the PEs of the image matrix get into Crosse Bridge (CB) (Figure 3) and perform in Ө (1) time [ELMES91]:

H = $i_{\min\_j_m}$ and $PE_H = PE_{(H,j_m)}$
G = $i_{\max\_j_m}$ and $PE_G = PE_{(G,j_m)}$
C = $i_{\min\_j_M}$ and $PE_C = PE_{(C,j_M)}$
D = $i_{\max\_j_M}$ and $PE_D = D_{(D,j_M)}$

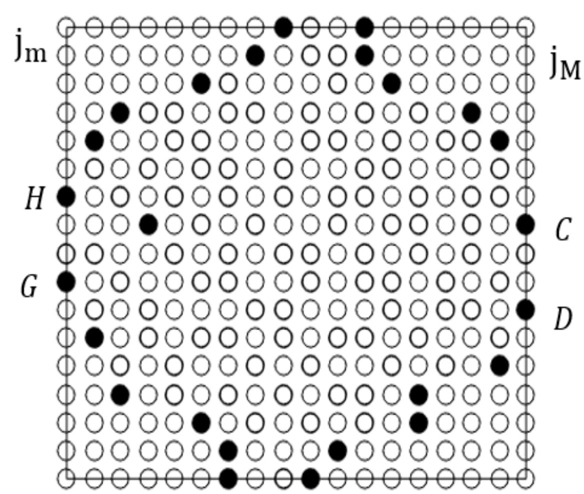


Figure 5 b: Min and Max columns

H = $i_{\min\_j_m}$, G = $i_{\max\_j_m}$
C = $i_{\min\_j_M}$, D = $i_{\max\_j_M}$

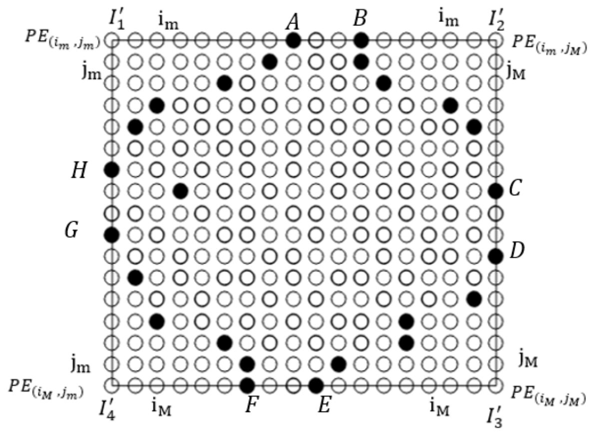


Figure 5: Summits: $PE_{(i_m,j_m)}$, $PE_{(i_m,j_M)}$, $PE_{(i_M,j_m)}$ $PE_{(i_M,j_M)}$et $PE_M : M \in \{A, B, C, D, E, F, G, H\}$. belonging to the sides of the quadrilateral encompassing the set of points of the image.

Step 2:

a) All PEs are configured in (SB) with respect to the line. (Figure 5).

b) The $PE_{(i_m,j_m)}$, $PE_{(i_M,j_m)}$, transmit on the bus on their right a code indicating their presence. All unmarked PEs will receive this code, those to the right of the two PEs having (i_m ,j_m) and (i_M , j_m).

c) The $PE_{(i_m,j_M)}$, $PE_{(i_M,j_M)}$ transmit on the bus to their left a code indicating their presence. All unmarked PEs will receive this code, those to the left of the two PEs having (i_m,j_M) and (i_M, j_M) .

d) The operations indicated in (a), (b) and (c) will be done on the columns.

e) Result: 4 PEs will receive 2 codes one on their line and another one on the columns and will memorize them in I'_1, I'_2, I'_3 and I'_4. (Figure 5).

Step 3:

a) All the PEs of the image matrix put themselves in (SB) on their column (Figure 6_a).

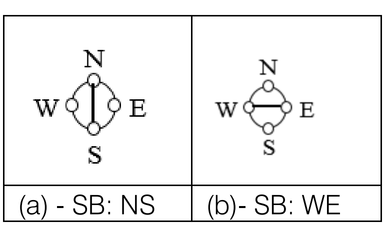


Figure 6: SB Rows and columns configuration (a) - SB: NS; (b)- SB: WE

b) The PE_A sends a code indicating the position of the column where it is located. So, all the PEs in this column will receive this code (Figure 7: quadrant P1).

c) All PEs in the image matrix are configured as (SB) on their line (Figure6-b).

The PE_H sends a code to all the PEs that are on his line. So, all PEs on this line will receive this code (Figure 7: quadrant P1). This operation runs for all others PEs:PE_B,PE_C,PE_D,PE_E,PE_F and PE_G.

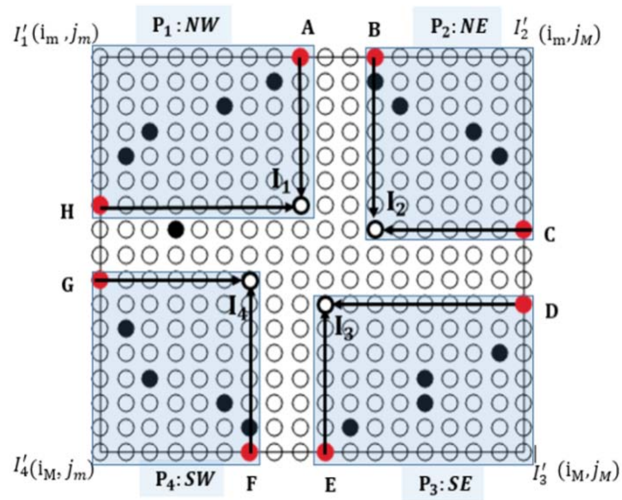


Figure 7: Determination of pointsI_1 , I_2 ,I_3 and I_4.

Step 4: Delimitation of the zones $P_1P_2P_3$and P_4: in the area P_1 (quadrant NW), all PEs that are between A and I_1 are in configuration (SB) on their column.

The PE_A gives them a code indicating that they have to block the bus that connects them with the PEs that are on their right (Figure 8.a).

In the same way PE_{I_1} communicates to the PEs that are in its line on the left, the code for disconnect PEs from the top line (Figure 8. a).

This operation will be executed in the zones P_2, P_3 and P_4.

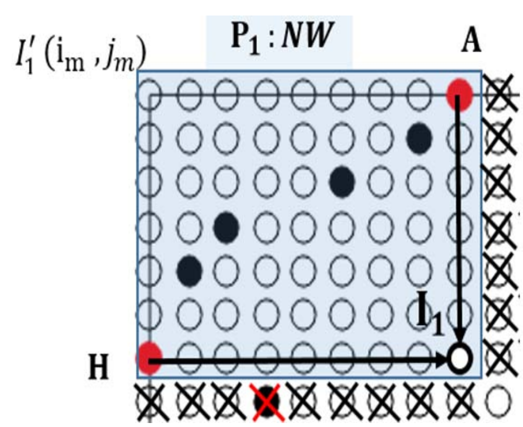


Figure 8 a: Delimitation of P_1 area.

Step 5: Labeling of the zones P_1, P_2, $P_3$and P_4: in zone P_1, since the PEs I'_1, A and I_1 are known, we proceed to the labeling all PEs belonging to P_1.

All the PEs in zone P1 are configured in Crosse Bridge (CB) state. The PE_{I_1} transmits an identifier code of the zone P1(Figure 8.b).

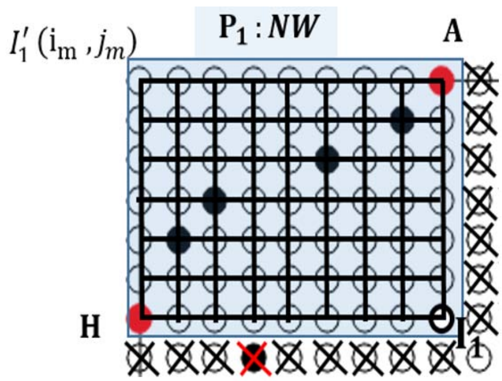


Figure 8b: Labeling of area P1

This operation will be executed in the zones P_2, P_3 and P_4 (Figure 8).

Consequence: All PEs in these areas are identified as part of the zones P_1, P_2, P_3 and P_4.

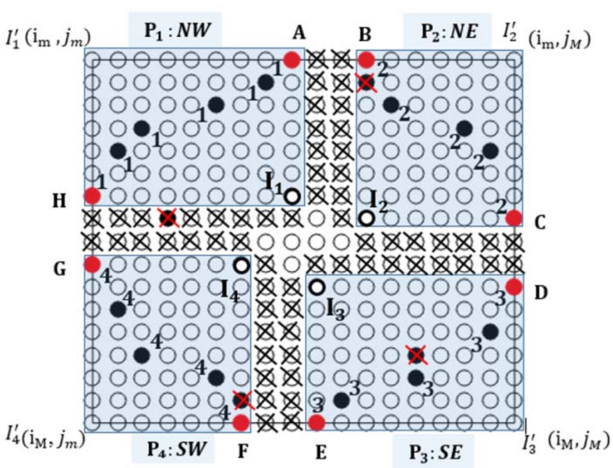


Figure 8: Delimitation and labeling of the zones P_1, P_2, P_3 and P_4.

Step 6: Elimination of all PEs that do not belong to the zones P_1, P_2, P_3 and P_4. (Figure 8).

a) All the PEs in the image matrix go into state (CB) except the PE I'_1.

b) The PEI_1' transmits to all PEs of the image matrix the cancellation order of marking if it is a marked PE. This implies that all PEs that do not belong to zones P_1, P_2, P_3 and P_4 will no longer be marked. Those who belong to these areas remain marked if they are.

Step 7: Treatment of labeled PEs belonging to zone P_i (Figure 9): Treatment of the area P_1 (Quadrant NW)

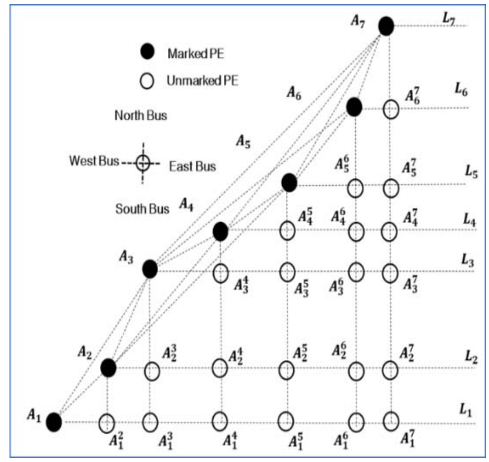


Figure 9: Treatment of the area P_1 (Quadrant NW)

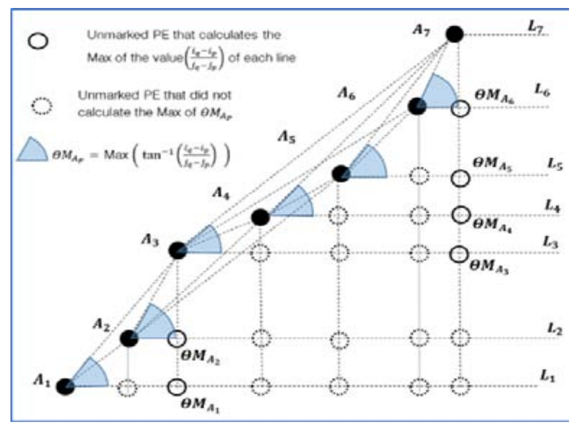


Figure 10: Determination of Max$\left(\frac{i_q-i_p}{j_q-j_p}\right)$

a) In each column only one PE marked, all others must be eliminated. Any Marked PE that has a labelled PE with an index lower than its index in the same column must be discarded. (Example, see Figure 8, zone P_3).

b) All unmarked PEs in the same column will execute the SB state except for only one remaining PE (A_7, A_6 , $A_5 A_4$, A_3 , A_2 and A_1).

c) Each marked PE transmits its position (i) on its south down column.

d) Each marked PE transmits on the East bus its position (j).

e) All the unmarked PEs A_p^q of row p and column q, which have received on the North and West buses the positions i_p and j_q ,calculate the value $\left(\frac{i_q-i_p}{j_q-j_p}\right)$ in (A_1^2 ,..,A_1^7 , A_2^3 ,..,A_2^7 , A_3^4 ,.., A_3^7 ,A_4^5 ,..., A_4^7 ,A_5^6 ,..., A_5^7 et A_6^7).

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

f) Each PE A_P^q calculate: $\left(\frac{i_q-i_p}{j_q-j_p}\right)$ or $\theta_P^q = \tan^{-1}\left(\frac{i_q-i_p}{j_q-j_p}\right)$, all the unmarked PEs of the line p execute the operation Max [ELMES91] in this line.

1. In the case of the line L_1 all $PE_1(A_1^2, ..., A_1^7)$ will run the Max's $\left(\frac{i_q-i_p}{j_q-j_p}\right)$ or $\theta M_{A_p} = \text{Max}(\theta_P^q)$ and we are going to have A_1^3 who will have the Max of $\left(\frac{i_q-i_p}{j_q-j_p}\right)$.
2. In the line L_2 the PE A_2^3 will have the Max.
3. In the line L_3 the PE A_3^7 will have the Max.
4. In the line L_4 the PE A_4^7 will have the Max.
5. In the line L_5 the PE A_5^7 will have the Max.
6. In the line L_6 the PE A_6^7 will have the Max.

g) All unmarked PEs, having already calculated θM_{A_p}, execute a Max [ELMES91] of the value $i = i_q - i_p$ on their column j_q.

Example:

1. In the line L_1, A_1^3 will be selected (it has the value $(i_3 - i_1)$ which is greater than $(i_3 - i_2)$)
2. In the line, A_3^7 will be selected (it has the value $(i_7 - i_3)$ which is greater than $(i_7 - i_4) > (i_7 - i_5) > (i_7 - i_6)$.
3. L_1, A_1^3 transmits through the open bus to the PE A_1^2 the order to eliminate the $PE_M(A_2)$ on its column.
4. L_3, A_3^7 transmits through the open bus to all PEs $A_3^4 A_3^5$ and A_3^6 the order to eliminate all PE_M on their column. In the other lines, no PE_M will be selected.

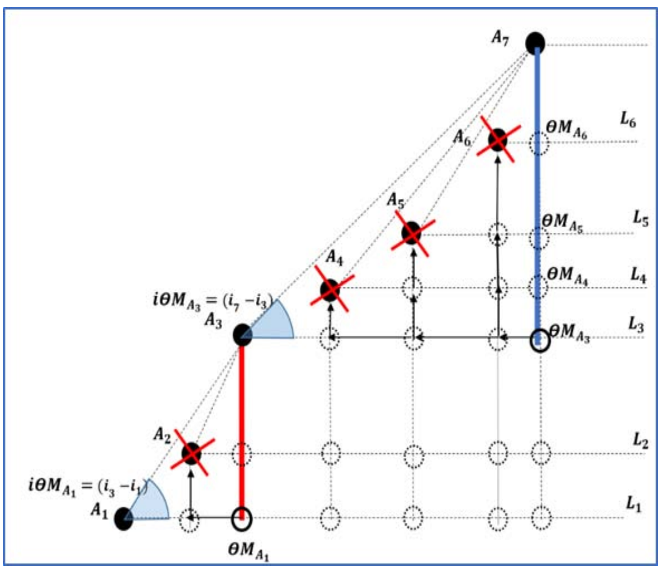


Figure 11: Max on the line index on the samecolumn

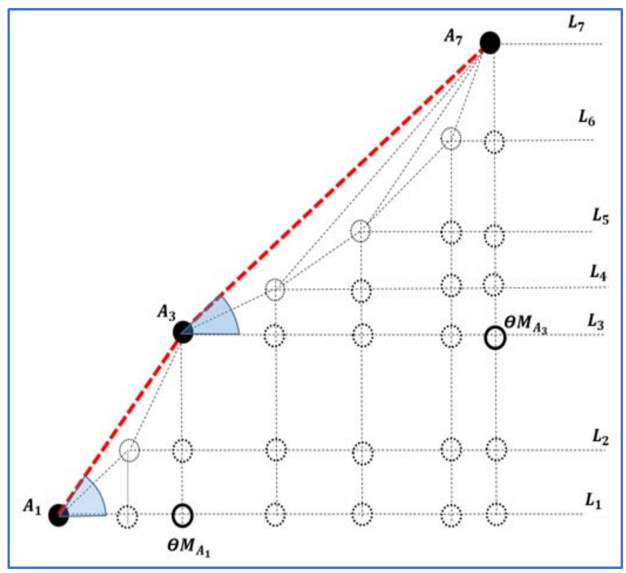


Figure 12: Result of the P1 zone The Marked PEs (PE_M)

Result: The Marked PEs ([[PE]]_M) : A_2 , A_4 , A_(5) and A_(6) are eliminated, the [[PE]]_M A_1 , A_3 and A_(7)belong to the convex hull of the area

IV. Conclusion

This paper has dealt with a parallel algorithm of determining the convex hull of a two-level 2D image with a complexity Θ (1) time. This is executed on a parallel machine (RMC), of size n x n Elementary Processors. The algorithm is essentially based on projections and the calculation of Min / Max in Θ (1) time. In a future work, we will extend this algorithm to 3D space and always in Θ (1) time.

References Références Referencias

1. [FU97]: FU A. M. N., and YAN H. *Effective classification of planar shapes based on curve segment properties*, Pattern Recognition Lett. 18 (1997), 55-61.
2. [CHO81]: CHOW P., *A parallel algorithm for determining convex hulls of sets of points in two dimensions*, in proc.19th Allerton Conf. Common., Contr., Comput., 1981, pp. 214-233.
3. [NAT81]: NATH S. N., MAHESHWARI N., and BHATT P. C. P., Parallel algorithms for the convex hull in two dimensions, in Proc. Conf. Anal. Problem Classes Programming Parallel Comput., 1981, pp. 358 -372.
4. [ALD83]: ALD M., *Parallel algorithms for convex hulls*, Dep. Comput. Sci., Queens Univ., Kingston, Ont., Canada 1983.
5. [KIM87]: KIM C. E., and STOJMENOVIC I. Parallel algorithms for digital geometry, CS-87-179, Washington State University, Pullman, December 1987.

6. [LIN93]: LING T., et al., Efficient Parallel processing of image contours, IEEE Trans. Pattern Anal. Mach. Intelligence 15(1) 1993, 69-81.
7. [PRA89]: PRASANNA V.K., and REISIS D.I. : Image computation on meshes with multiple broadcast, IEEE Trans. Pattern Anal. Mach. Intelligence 11(11) (1989),1194-1201.
8. [MIL85]: MILLER R., and al.: *Geometric algorithms for digitized pictures on a mesh connected computer*, IEEE Trans. Pattern Anal. Mach. Intelligence 7(2) (1985).
9. [LI89]: LI H., MARESCA M., *Polymorphic Torus Architecture for Computer Vision*, IEEE Trans. on PAMI. Vol.11, n°3, pp. 233-242, March89.
10. [HAY98]: HAYACHI T. et al.: An (O (log log n)^2) time algorithm to compute the convex hull of sorted point on a reconfigurable meshes, IEEE trans. Parallel Distrib. Sys. 9(12) 1998, 1167-1179.
11. [ERR05]: ERRAMI A., KHALDOUN M., ELMESBAHI J., and BOUATTANE M., Θ (1) time algorithm for structural characterization of multi-level images and its applications on a reconfigurable mesh computer, Journal of Intelligent and Robotics Systems, 2005.
12. [BOU02]: BOUATTANE O., ELMESBAHI J., ERRAMI A., *A fast parallel algorithm for convex hull problem of multi-leveled images*, Journal of Intelligent and Robotic Systems 33: 285-299, 2002.
13. [ELMES86]: J. Elmesbahi and J. Cherkaoui, Structure Analysis for Gray level Pictures on a mesh connected computer, Proc. of IEEE Internat. Conf. on SMC, 10 (1986), 1415-1419.
14. [ELMES91]: J. El Mesbahi, Θ (1) algorithm for image component labeling in a mesh connected computer, IEEE Trans. Syst. Man Cybern., 21 (1991), 427-433.
15. https://doi.org/10.1109/21.87089.

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 21 Issue 1 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Texture Classification of 3D Mr Color Images using 3D Orthogonal Rank Filters

By Arun Kumar A & E. G. Rajan
University of Mysore

Abstract- The term 'texture' refers to patterns arranged in an order in a line or a curve. Textures allow one to make a meaningful interpretation of certain geometric regularity of spatially repeated patterns. In addition, texture also exhibits useful information about spatial distribution of color or gray intensities in an image. Correct interpretation of latent textures of various tissues in a body is an important requirement for a surgeon as a preoperative measure. In this context, extraction of textures in an MR scanned 3D image would assist a medical professional in the preoperative decision making process. This paper proposes a novel technique for extracting directional textures of a 3D MR image in all three axes separately.

Keywords: 3D color images, superficial and volumetric features, texture classification.

GJCST-F Classification: I.2.10

TEXTURECLASSIFICATIONOF3DMRCOLORIMAGESUSING3DORTHOGONALRANKFILTERS

Strictly as per the compliance and regulations of:

Texture Classification of 3D Mr Color Images using 3D Orthogonal Rank Filters

Arun Kumar A [α] & E. G. Rajan [σ]

Abstract- The term 'texture' refers to patterns arranged in an order in a line or a curve. Textures allow one to make a meaningful interpretation of certain geometric regularity of spatially repeated patterns. In addition, texture also exhibits useful information about spatial distribution of color or gray intensities in an image. Correct interpretation of latent textures of various tissues in a body is an important requirement for a surgeon as a preoperative measure. In this context, extraction of textures in an MR scanned 3D image would assist a medical professional in the preoperative decision making process. This paper proposes a novel technique for extracting directional textures of a 3D MR image in all three axes separately.

Keywords: 3D color images, superficial and volumetric features, texture classification.

I. Introduction

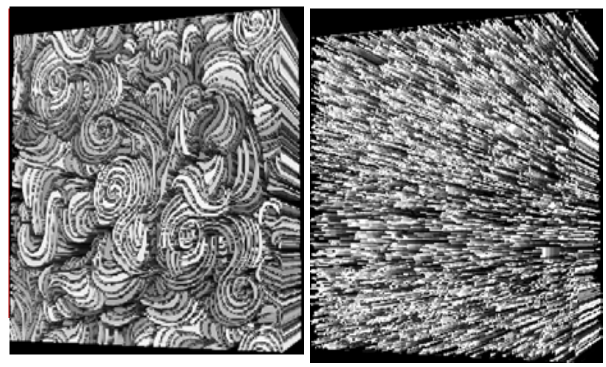
This paper describes a computationally efficient technique to detect various texture characteristics as directional features in a given 3D digital image. The computational tool used for this purpose is '3D Rank Filters', which are essentially directional filters. These filters cause radical changes in the original content of a given image but precisely extract various textures.

Any given 3D MR image consists of texture features of tissues corresponding to muscle fibers in almost all directions. One can visualize major muscle fibers of a body component with naked eye. But most of the finer textures cannot be visualized even by an expert, in which case machine vision support system becomes quite handy. The algorithms presented in this paper could be used to detect texture patterns in al the three orthogonal axes of a 3D rectangular discrete coordinate system in which 3D digital image is displayed.

II. Liteerature Survey

Apart from detecting latent textures in a given image, one can also artificially create texture images. Fig. 1 shows a 3D texture image, which is artificially generated using a cellular automaton rule.

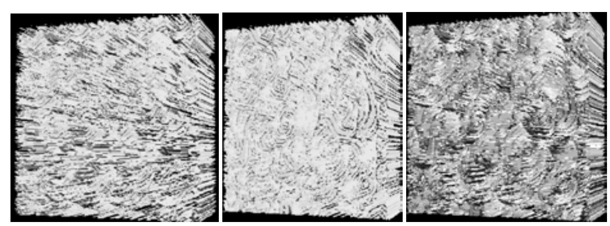
Author α: Department of Computer Science University of Mysore, Manasa Gangotri Mysore, Karnataka, India.
e-mail: arun.arigala@gmail.com
Author σ: Director, Rajiv Gandhi International School of Information Technology, MG-MIRSA Approved Research Centre of Mysore University. e-mail: rajaneg@yahoo.co.in



(a) Image 1 (b) Image 2

Figure 1: Texture images due to cellular automaton rules

Fig. 2 shows texture patterns extracted from image 2 shown in Fig. 1 along three axes of 3D rectangular coordinate system.



Textures along x axis Textures along y axis Textures along z axis

Figure 2: Textures along all axes of 3D coordinate system

Two texture features are usually considered for image segmentation. They are (i) spatial frequency features and (ii) average gray level features. Either 'structural approach' or 'statistical approach' could be used for developing texture detection algorithms. Mostly statistical approach is considered for texture classification because of ease in parametrization and quantification of texture features.

Edge detection is a method by which one would be able to detect edge pixels details which help determine characteristics of texture complexities. For instance, directions of edges could be treated as characteristics of textures in determining patterns in the textures.

Consider a region with N pixels in a given image. Any gradient-based edge detector algorithm could be applied to this region, which would yield two outputs for every pixel p, viz, 'gradient magnitude

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

Mag(p)' and 'gradient direction' Dir(p). Now, the edgeness per unit area of a given image is defined by the expression $\frac{|\{p|Mag(p) > T\}|}{N}$ for some predefined threshold T. Let $H_{mag}(R)$ be the normalized histogram of the gradient magnitudes of the region of interest R, and let $H_{dir}(R)$ be the normalized histogram of the gradient orientations of the region of interest R. Both are normalized according to the size N_R Then, one can define a quantitative measure $F_{mag,dir} = (H_{mag}(R), H_{dir}(R))$ for describing texture of the region of interest R.

Another technique to quantify texture is 'co-occurrence matrix', which defines features of a texture using certain spatial relations of similar gray values. Such numerical features could be used for texture classification. Some of the standard features from a normalized co-occurrence matrix are given below.

Angular 2nd moment = $\sum_i \sum_j p[i,j]^2$

Contrast = $\sum_{i=1}^{Ng} \sum_{j=1}^{Ng} n^2 p[i,j]$, where $|i-j| = n$

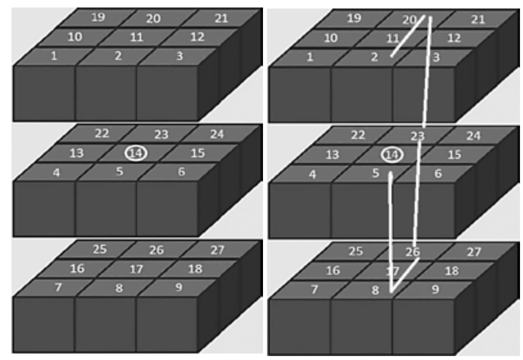
Correlation = $\frac{\sum_{i=1}^{Ng} \sum_{j=1}^{Ng} (ij)p[i,j] - \mu_x \mu_y}{\sigma_x \sigma_y}$

Entropy = $-\sum_i \sum_j p[i,j] ln(p[i,j])$

where *p[i, j]* is the *[i, j]*th entry in a gray-level spatial dependence matrix, and Ng is the number of gray-values in the quantized image. It is to be noted that the co-occurrence matrix based feature extraction will not yield comfortable visual perception.

III. Proposed Method

As outlined earlier, the term 'textures' refers to 'repeated patterns' in a given image. Consider the 27-neighborhood window shown in Fig. 3. The cells 1, 2, 3, 4, 5, 6, 7, 8, 9 form the first plane, 10, 11, 12, 13, 14, 15, 16, 17, 18 the middle plane and cells 19, 20, 21, 22, 23, 24, 25, 26, 27 form the rear plane of the window. The given 3-D digital image is plane-wise raster-scanned by this window (See Fig. 3). In order to extract 3-D linear textures along an axis with a directional twist, one has to choose that particular axis and its associated rank of a particular directional twist. For example if one chooses the X axis and rank1 of zero directional twist, values in cells 2,11,20,23,26,17,8,5 would be read and stored in an array. The reading pattern is shown in Fig. 4.



(a) Labeled window (b) Reading direction

Figure 3: 27-neighborhood window in layer form and the reading direction

The values of the cells 2,11,20,23,26,17,8,5 are the boundary values corresponding to the central voxel 14. The plane formed by these cells is perpendicular to the X axis as shown in Fig. 4.

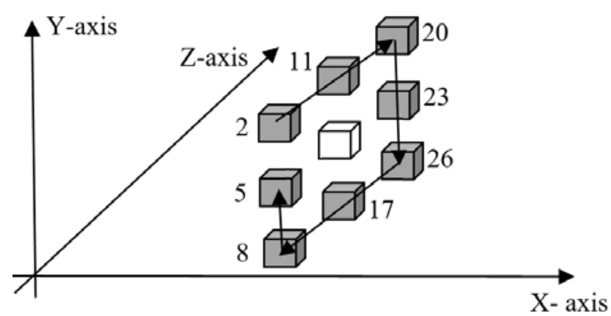


Figure 4: 3D coordinate axes and the reading plane

X-axis rank 2 consists of cells 11, 20, 23, 26, 17, 8, 5, 2 and the corresponding plane is perpendicular to X axis as given in Fig. 4 but with a directional twist of 45 degrees. One can construct four ranks in X-axis, four in Y-axis and another four in Z-axis as shown in Table 1. A total of 12 rank filters could be constructed in three axes which are called "3D Orthogonal Rank Filters".

Table 1: Ranks filters in all three axes

Axes	Ranks	Cell sequences
X	X1	2,11,20,23,26,17,8,5
	X2	11,20,23,26,17,8,5,2
	X3	20,23,26,17,8,5, 2,11
	X4	23,26,17,8,5, 2,11,20
Y	Y1	4,13,22,23,24,15,6,5
	Y2	13,22,23,24,15,6,5,4
	Y3	22,23,24,15,6,5,4,13
	Y4	23,24,15,6,5,4,13,22
Z	Z1	10, 11,12,15,18,17,16,13
	Z2	11,12,15,18,17,16,13,10
	Z3	12,15,18,17,16,13,10, 11
	Z4	15,18,17,16,13,10, 11,12

IV. Texture Classification of 3D Medical Images

Textures of a medical image play an important role in support of a surgeon to decide the angle at which the surgical blade should be used to make incision so that the loss of blood due to surgery is kept minimum. A case study was carried out to verify the validity of the algorithm and the result of the study presented in Fig. 5, which is self-explanatory.

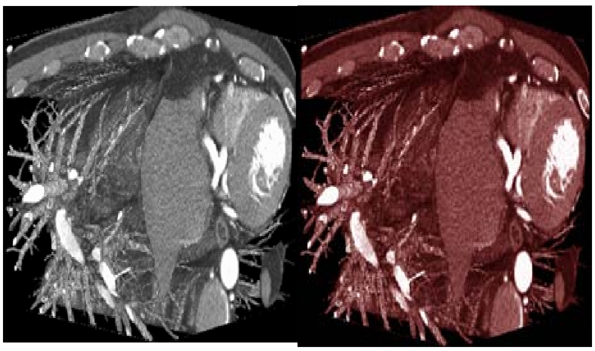


Figure 5: Sample MRI image and its colored version

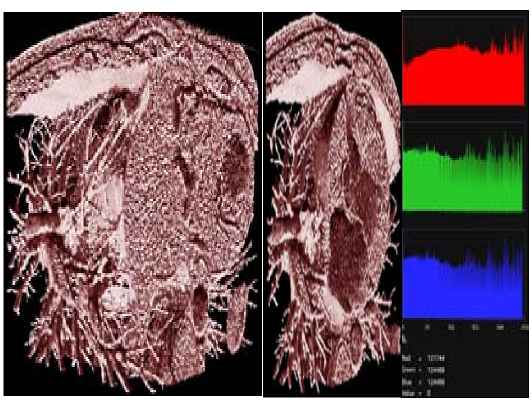


Figure 6: Rank x1 filtered, sectioned (30-140) and histogram

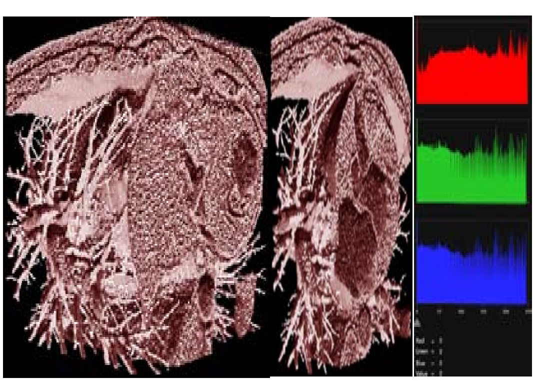


Figure 7: Rank x2 filtered, sectioned (30-140) and histogram

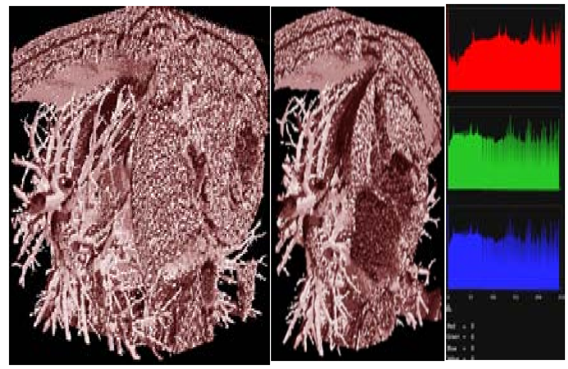


Figure 8: Rank x3 filtered, sectioned (30-140) and histogram

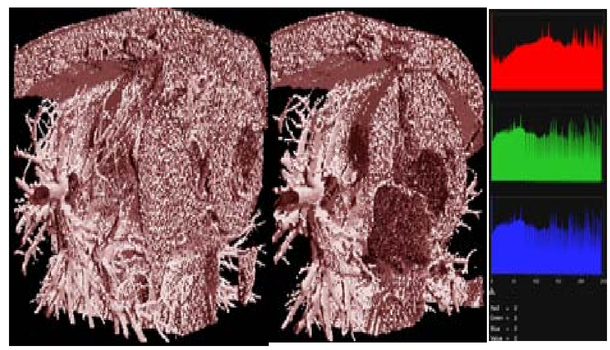


Figure 9: Rank x4 filtered, sectioned (30-140) and histogram

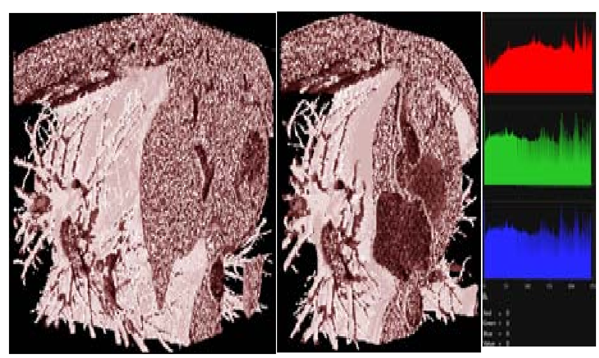


Figure 10: Rank y1 filtered, sectioned (30-140) and histogram

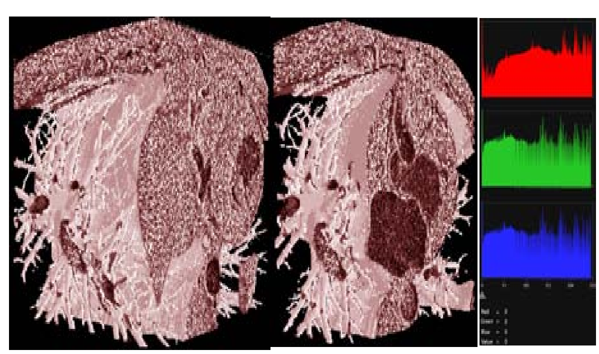


Figure 11: Rank y2 filtered, sectioned (30-140) and histogram

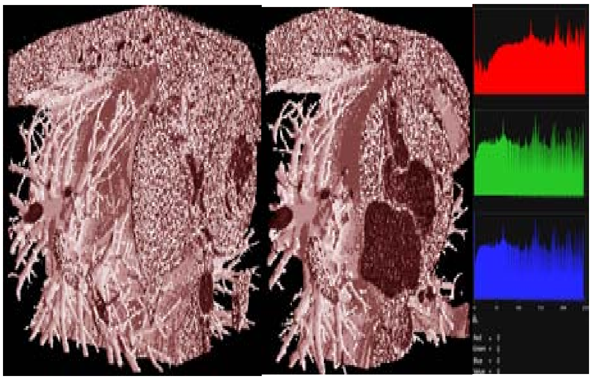


Figure 12: Rank y3 filtered, sectioned (30-140) and histogram

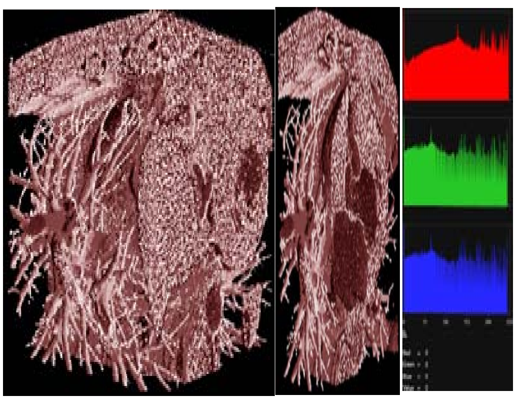


Figure 13: Rank y4 filtered, sectioned (30-140) and histogram

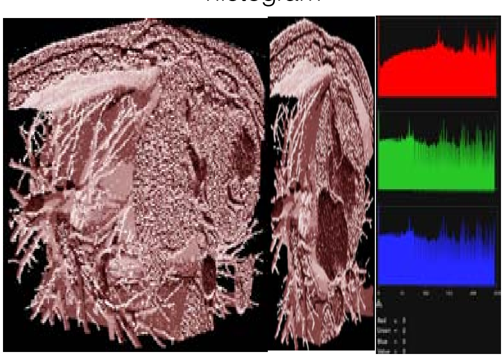


Figure 14: Rank z1 filtered, sectioned (30-140) and histogram

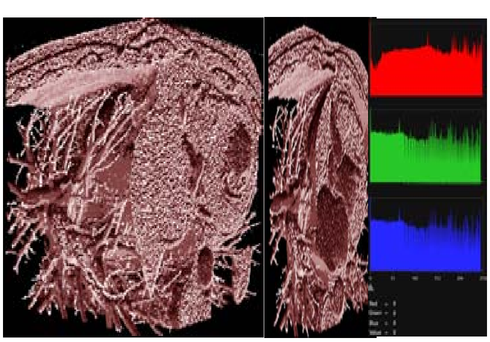


Figure 15: Rank z2 filtered, sectioned (30-140) and histogram

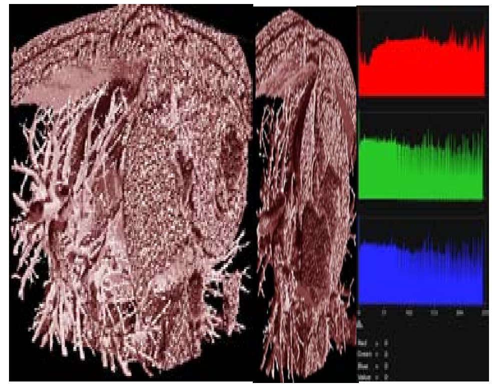


Figure 16: Rank z3 filtered, sectioned (30-140) and histogram

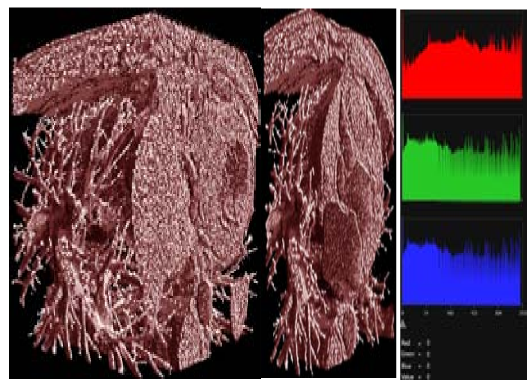


Figure 17: Rank z4 filtered, sectioned (30-140) and histogram

V. Statistical Results

Original 3D image statistics

Pixels Count	568089
Pixels without black	449360
Red Min	0
Red Max	252
Red Mean	90.0212677943069
Red Standard Deviation	65.4300367403954
Red Median	92
Red Total Count	568089
Green Min	0
Green Max	249
Green Mean	48.2296154299766
Green Standard Deviation	56.6653938791041
Green Median	33
Green Total Count	568089
Blue Min	0
Blue Max	249
Blue Mean	48.2296154299766
Blue Standard Deviation	56.6653938791041
Blue Median	33
Blue Total Count	568089
Saturation Min	0
Saturation Max	1
Saturation Mean	0.347210377454758

Saturation Standard Deviation	0.225063592195511
Saturation Median	0.341176480054855
Luminance Min	0
Luminance Max	0.980392158031464
Luminance Mean	0.270397782325745
Luminance Standard Deviation	0.234511524438858
Luminance Median	0.243137255311012
Y Min	0
Y Max	0.976470589637756
Y Mean	0.236716106534004
Y Standard Deviation	0.227980986237526
Y Median	0.196078434586525
Cb Min	-0.0450980365276337
Cb Max	-0.00196078419685364
Cb Mean	-0.0298237334936857
Cb Standard Deviation	0.0168844126164913
Cb Median	-0.0372548997402191
Cr Min	-0.00196078419685364
Cr Max	0.123529434204102
Cr Mean	0.0804557129740715
Cr Standard Deviation	0.0502428002655506
Cr Median	0.103921592235565
Red Min WB	1
Red Max WB	252
Red Mean WB	113.806507032224
Red Standard Deviation WB	52.0126491068468
Red Median WB	111
Red Total Count WB	449360
Green Min WB	0
Green Max WB	249
Green Mean WB	60.972747908136
Green Standard Deviation WB	57.2920439382876
Green Median WB	48
Green Total Count WB	449360
Blue Min WB	0
Blue Max WB	249
Blue Mean WB	60.972747908136
Blue Standard Deviation WB	57.2920439382876
Blue Median WB	48
Blue Total Count WB	449360
Saturation Min WB	0.235294118523598
Saturation Max WB	1
Saturation Mean WB	0.43894961476326
Saturation Standard Deviation WB	0.154169782996178
Saturation Median WB	0.396078437566757
Luminance Min WB	0
Luminance Max WB	0.980392158031464
Luminance Mean WB	0.341841757297516
Luminance Standard Deviation WB	0.212376952171326
Luminance Median WB	0.309803932905197
Y Min WB	0
Y Max WB	0.976470589637756
Y Mean WB	0.299260765314102
Y Standard Deviation WB	0.216774046421051
Y Median WB	0.258823543787003
Cb Min WB	-0.0450980365276337
Cb Max WB	-0.00196078419685364
Cb Mean WB	-0.0371856279671192
Cb Standard Deviation WB	0.0100541561841965
Cb Median WB	-0.0411764681339264
Cr Min WB	0.00196081399917603
Cr Max WB	0.123529434204102
Cr Mean WB	0.10223163664341
Cr Standard Deviation WB	0.0303715113550425
Cr Median WB	0.115686297416687

Rank X1 filtered image statistics

Pixels Count	563200
Pixels without black	441456
Red Min	0
Red Max	252
Red Mean	122.136278409091
Red Standard Deviation	87.516547830135
Red Median	121
Red Total Count	563200
Green Min	0
Green Max	249
Green Mean	88.18859375
Green Standard Deviation	85.5399836766261
Green Median	57
Green Total Count	563200
Blue Min	0
Blue Max	249
Blue Mean	88.18859375
Blue Standard Deviation	85.5399836766261
Blue Median	57
Blue Total Count	563200
Saturation Min	0
Saturation Max	1
Saturation Mean	0.30152890086174
Saturation Standard Deviation	0.202493324875832
Saturation Median	0.317647069692612
Luminance Min	0
Luminance Max	0.980392158031464
Luminance Mean	0.411772221326828
Luminance Standard Deviation	0.335566163063049
Luminance Median	0.34901961684227
Y Min	0
Y Max	0.976470589637756
Y Mean	0.384158581495285
Y Standard Deviation	0.334127157926559
Y Median	0.298039227724075
Cb Min	-0.0450980365276337
Cb Max	-0.00196078419685364
Cb Mean	-0.0245320294052362
Cb Standard Deviation	0.0166890006512403
Cb Median	-0.0254901945590973
Cr Min	-0.00196078419685364
Cr Max	0.123529434204102
Cr Mean	0.0646790862083435
Cr Standard Deviation	0.0495649240911007
Cr Median	0.0686274766921997

Red Min WB	1
Red Max WB	252
Red Mean WB	155.818817730419
Red Standard Deviation WB	67.2532471235556
Red Median WB	150
Red Total Count WB	441456
Green Min WB	0
Green Max WB	249
Green Mean WB	112.509097169367
Green Standard Deviation WB	81.2324164509591
Green Median WB	88
Green Total Count WB	441456
Blue Min WB	0
Blue Max WB	249
Blue Mean WB	112.509097169367
Blue Standard Deviation WB	81.2324164509591
Blue Median WB	88
Blue Total Count WB	441456
Saturation Min WB	0.235294118523598
Saturation Max WB	1
Saturation Mean WB	0.384684056043625
Saturation Standard Deviation WB	0.142558693885803
Saturation Median WB	0.329411774873734
Luminance Min WB	0
Luminance Max WB	0.980392158031464
Luminance Mean WB	0.525330066680908
Luminance Standard Deviation WB	0.289833068847656
Luminance Median WB	0.466666668653488
Y Min WB	0
Y Max WB	0.976470589637756
Y Mean WB	0.490101218223572
Y Standard Deviation WB	0.300843000411987
Y Median WB	0.415686279535294
Cb Min WB	-0.0450980365276337
Cb Max WB	-0.00196078419685364
Cb Mean WB	-0.0307566896080971
Cb Standard Deviation WB	0.013269835151732
Cb Median WB	-0.0333333313465118
Cr Min WB	0.00196081399917603
Cr Max WB	0.123529434204102
Cr Mean WB	0.0830569192767143
Cr Standard Deviation WB	0.039645180106163
Cr Median WB	0.0960784554481506

Rank Y1 filtered image statistics

Pixels Count	559680
Pixels without black	440208
Red Min	0
Red Max	252
Red Mean	140.256889651229
Red Standard Deviation	91.295496046247
Red Median	155
Red Total Count	559680
Green Min	0
Green Max	249
Green Mean	109.47983133219
Green Standard Deviation	89.8741846221284
Green Median	94
Green Total Count	559680
Blue Min	0
Blue Max	249
Blue Mean	109.47983133219
Blue Standard Deviation	89.8741846221284
Blue Median	94
Blue Total Count	559680
Saturation Min	0
Saturation Max	1
Saturation Mean	0.275802910327911
Saturation Standard Deviation	0.171386480331421
Saturation Median	0.30588236451149
Luminance Min	0
Luminance Max	0.980392158031464
Luminance Mean	0.489122450351715
Luminance Standard Deviation	0.351963937282562
Luminance Median	0.486274510622025
Y Min	0
Y Max	0.976470589637756
Y Mean	0.463929653167725
Y Standard Deviation	0.35080423951149
Y Median	0.439215689897537
Cb Min	-0.0450980365276337
Cb Max	-0.00196078419685364
Cb Mean	-0.0224275775253773
Cb Standard Deviation	0.015973724424839
Cb Median	-0.02156862616539
Cr Min	-0.00196078419685364
Cr Max	0.123529434204102
Cr Mean	0.0583211965858936
Cr Standard Deviation	0.0472652688622475
Cr Median	0.0607843399047852
Red Min WB	1
Red Max WB	252
Red Mean WB	178.322465743467
Red Standard Deviation WB	61.7170538248096
Red Median WB	204
Red Total Count WB	440208
Green Min WB	0
Green Max WB	249
Green Mean WB	139.192545342202
Green Standard Deviation WB	78.318391541463
Green Median WB	163
Green Total Count WB	440208
Blue Min WB	0
Blue Max WB	249
Blue Mean WB	139.192545342202
Blue Standard Deviation WB	78.318391541463
Blue Median WB	163
Blue Total Count WB	440208
Saturation Min WB	0.235294118523598
Saturation Max WB	1
Saturation Mean WB	0.350655525922775

Saturation Standard Deviation WB	0.105345770716667
Saturation Median WB	0.321568638086319
Luminance Min WB	0
Luminance Max WB	0.980392158031464
Luminance Mean WB	0.621869742870331
LuminanceStandardDeviation WB	0.273765563964844
Luminance Median WB	0.717647075653076
Y Min WB	0
Y Max WB	0.976470589637756
Y Mean WB	0.589839696884155
Y Standard Deviation WB	0.286698818206787
Y Median WB	0.686274528503418
Cb Min WB	-0.0450980365276337
Cb Max WB	-0.00196078419685364
Cb Mean WB	-0.0279822442680597
Cb Standard Deviation WB	0.0134115405380726
Cb Median WB	-0.0254901945590973
Cr Min WB	0.00196081399917603
Cr Max WB	0.123529434204102
Cr Max WB	0.123529434204102
Cr Mean WB	0.0746816620230675
Cr Standard Deviation WB	0.0398297160863876
Cr Median WB	0.0686274766921997

Rank Z1 filtered image statistics

Pixels Count	573516
Pixels without black	440594
Red Min	0
Red Max	252
Red Mean	124.623138674422
Red Standard Deviation	86.0969667214582
Red Median	130
Red Total Count	573516
Green Min	0
Green Max	249
Green Mean	89.6711966187517
Green Standard Deviation	80.8826837693388
Green Median	66
Green Total Count	573516
Blue Min	0
Blue Max	249
Blue Mean	89.6711966187517
Blue Standard Deviation	80.8826837693388
Blue Median	66
Blue Total Count	573516
Saturation Min	0
Saturation Max	1
Saturation Mean	0.272191524505615
Saturation Standard Deviation	0.184789970517159
Saturation Median	0.298039227724075
Luminance Min	0
Luminance Max	0.980392158031464
Luminance Mean	0.419556379318237
Luminance Standard Deviation	0.323453366756439
Luminance Median	0.384313732385635
Y Min	0
Y Max	0.976470589637756
Y Mean	0.391311198472977
Y Standard Deviation	0.319555670022964
Y Median	0.333333343267441
Cb Min	-0.0450980365276337
Cb Max	-0.00196078419685364
Cb Mean	-0.0252390317618847
Cb Standard Deviation	0.0168824307620525
Cb Median	-0.0294117629528046
Cr Min	-0.00196078419685364
Cr Max	0.123529434204102
Cr Mean	0.066443957388401
Cr Standard Deviation	0.0499764792621136
Cr Median	0.0803921818733215
Red Min WB	1
Red Max WB	252
Red Mean WB	162.220466007254
Red Standard Deviation WB	59.5814731225976
Red Median WB	163
Red Total Count WB	440594
Green Min WB	0
Green Max WB	249
Green Mean WB	116.723936322328
Green Standard Deviation WB	73.1980388120368
Green Median WB	104
Green Total Count WB	440594
Blue Min WB	0
Blue Max WB	249
Blue Mean WB	116.723936322328
Blue Standard Deviation WB	73.1980388120368
Blue Median WB	104
Blue Total Count WB	440594
Saturation Min WB	0.235294118523598
Saturation Max WB	1
Saturation Mean WB	0.354308485984802
Saturation StandardDeviation WB	0.123913042247295
Saturation Median WB	0.317647069692612
Luminance Min WB	0
Luminance Max WB	0.980392158031464
Luminance Mean WB	0.546131551265717
LuminanceStandardDeviationWB	0.258956789970398
Luminance Median WB	0.521568655967712
Y Min WB	0
Y Max WB	0.976470589637756
Y Mean WB	0.509365200996399
Y Standard Deviation WB	0.269796907901764
Y Median WB	0.474509805440903
Cb Min WB	-0.0450980365276337
Cb Max WB	-0.00196078419685364
Cb Mean WB	-0.0322618037462234
Cb Standard Deviation WB	0.0125779723748565
Cb Median WB	-0.0333333313465118
Cr Min WB	0.00196081399917603
Cr Max WB	0.123529434204102
Cr Mean WB	0.0870808660984039
Cr Standard Deviation WB	0.0375980846583843
Cr Median WB	0.0960784554481506

Table 2: Comparison og selected statistical parameters

Selected Statistical Parameter	Original Image	Rank X1 Filtered Image	Rank Y1 Filtered Image	Rank Z1 Filtered Image
Red Min	0	0	0	0
Red Max	252	252	252	252
Red Mean	90.02	122.13	140.25	124.62
Red Standard Deviation	65.43	87.51	91.29	86.09
Red Median	92	121	155	130
Red Total Count	568089	563200	559680	573516
Green Min	0	0	0	0
Green Max	249	249	249	249
Green Mean	48.22	88.18	109.47	89.67
Green Standard Deviation	56.66	85.531	89.87	80.88
Green Median	33	57	94	66
Green Total Count	568089	563200	559680	573516
Blue Min	0	0	0	0
Blue Max	249	249	249	249
Blue Mean	48.22	88.18	109.47	89.67
Blue Standard Deviation	56.66	85.53	89.87	80.88
Blue Median	33	57	94	66
Blue Total Count	568089	563200	559680	573516

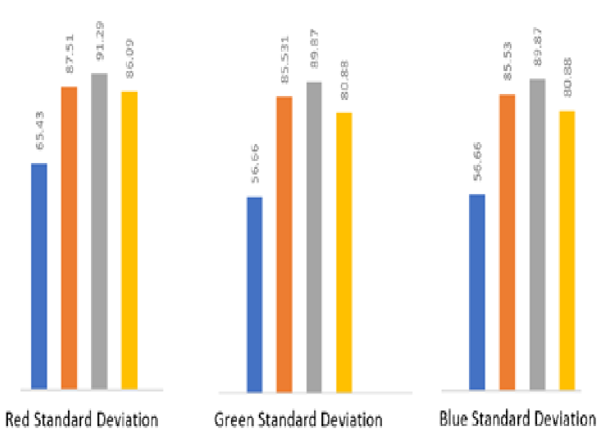


Figure 18: Graph showing textures statistics

VI. Conclusion

From the experimental study, it was observed that the variations in the statistical parameter values remain almost uniform, especially standard deviations of Red, Green and Blue values. One can infer similar behavior as far as other parameters also.

All four texture versions of the image obtained using rank filters could be seen to provide a visual proof of the fact textures in an image are direction sensitive and so they could be used for image segmentation purposes.

Acknowledgment

The authors thank the administration of Avatar MedVision US LLC, NC, USA and Pentagram Research Centre Private Limited, Hyderabad, India various hospitals both in India and USA for providing actual MR Images for the intended study. Technical support from Mr. Srikanth Maddikunta of Pentagram Research Centre Pvt Ltd, Hyderabad, India, is duly acknowledged.

References Références Referencias

1. Rajan E. G., "Symbolic computing: signal and image processing", Anshan Publications, Kent, United Kingdom, 2003.
2. Rajan E. G., "Cellular logic array processing for high through put image processing systems", Sadhana, Vol. 18, issue 2, pp. 279-300, Springer.
3. Rajan E. G., "Fast algorithm for detecting volumetric and superficial features in 3-D images", International Conference on Biomedical Engineering, Osmania University, Hyderabad, 1994.
4. Rajan E. G., "Medical imaging in the framework of cellular logic array processing", in Proc. 15th Annu. Conf. Biomedical Society of India, Coimbatore Institute of Technology, 1996.
5. G. Ramesh Chandra, Towheed Sultana, G. Sathya, "Algorithms for Generating Convex Polyhedrons In A Three Dimensional Rectangular Array Of Cells", International Journal of Systemics, Cybernetics and Informatics, April, 2011, pp 24-34.
6. G. Ramesh Chandra, and E. G. Rajan, "Generation of Three Dimensional Structuring elements over 3x3x3 Rectangular Grid", CIIT International Journal of Digital Image Proc. Vol. 4, No.2, February 2012, pp.80-89.
7. G. Ramesh Chandra and E. G. Rajan, "Algorithms for generating convex polyhedrons over three dimensional rectangular grid"; Signal & Image Processing : An International Journal (SIPIJ), Vol.3, No.2, April 2012, pp. 197-206
8. G. Ramesh Chandra and E. G. Rajan, "Algorithm for Constructing Complete Distributive Lattice of Polyhedrons Defined over Three Dimensional Rectangular Grid- Part II"; CCSIT Conference, Bangalore, proceedings are published by LNICST, Springer, pp. 202-208.

This page is intentionally left blank

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 21 Issue 1 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

The Impact of Different Image Thresholding based Mammogram Image Segmentation- A Review

By Krishnaveni

Abstract- Images are examined and discretized numerical capacities. The goal of computerized image processing is to enhance the nature of pictorial data and to encourage programmed machine elucidation. A computerized imaging framework ought to have fundamental segments for picture procurement, exceptional equipment for encouraging picture applications, and a tremendous measure of memory for capacity and info/yield gadgets. Picture segmentation is the field broadly scrutinized particularly in numerous restorative applications and still offers different difficulties for the specialists. Segmentation is a critical errand to recognize districts suspicious of tumor in computerized mammograms. Every last picture have distinctive sorts of edges and diverse levels of limits. In picture transforming, the most regularly utilized strategy as a part of extricating articles from a picture is "thresholding". Thresholding is a prevalent device for picture segmentation for its straightforwardness, particularly in the fields where ongoing handling is required.

GJCST-F Classification: *I.2.10*

THEIMPACTOFDIFFERENTIMAGETHRESHOLDINGBASEDMAMMOGRAMIMAGESEGMENTATIONAREVIEW

Strictly as per the compliance and regulations of:

The Impact of Different Image Thresholding based Mammogram Image Segmentation- A Review

Krishnaveni

Abstract- Images are examined and discretized numerical capacities. The goal of computerized image processing is to enhance the nature of pictorial data and to encourage programmed machine elucidation. A computerized imaging framework ought to have fundamental segments for picture procurement, exceptional equipment for encouraging picture applications, and a tremendous measure of memory for capacity and info/yield gadgets. Picture segmentation is the field broadly scrutinized particularly in numerous restorative applications and still offers different difficulties for the specialists. Segmentation is a critical errand to recognize districts suspicious of tumor in computerized mammograms. Every last picture have distinctive sorts of edges and diverse levels of limits. In picture transforming, the most regularly utilized strategy as a part of extricating articles from a picture is "thresholding". Thresholding is a prevalent device for picture segmentation for its straightforwardness, particularly in the fields where ongoing handling is required. Thresholding is the procedure of creating uniform locales taking into account the edge esteem. It is the methodology of utilizing a limit to concentrate the Region of Interest (ROI). In this paper we have talked about numerous edge choice routines, for example, histogram, clustering, entropy, object attribute, spatial and local methods are exceptionally valuable systems and the acquired results are analyzed in an indicated way. Accordingly Image transforming applications are exhibit in all spaces.

I. Introduction

Digital Image Processing is a quickly advancing field with developing applications in science and engineering [3]. Digital image processing is adaptable research in this period [1]. Scientific visualization is the representation of data graphically as a means of gaining understanding and insight into the information. A wonderful place to start out learning scientific visualization is within the field of image process, since it involves algorithms that facilitate convert information into pictures. In today's technology-oriented world, the term `image process' usually refers to the processing of a two-dimensional information set employing a computer [7]. Digital image processing involves the control and investigation of images or pictures utilizing digital computers [5]. Alongside the advancement of data innovation with the development of information technology (IT), computerized sign loaded with the entire world, so see the picture changed over to be computer to manage an advanced sign. Advanced picture transforming is through computer instrument, with computerized picture motion by a progression of handling operations, and get individuals with the needs of the application [4].

Many researchers implement differing types of organizations like image restoration, image improvement, color image process, image segmentation etc. Image improvement technique is among the only and most appealing space of digital image process. Improvement techniques like intensity conservation, distinction improvement highlight sure options means that rely that a part of the image wish to be enhance some application some input image as well as noise, reduction or removal of noise is additionally style of image improvement. Brightness preservation has increased visual quality of digital image in order that the limitation contained in these pictures is employed for varied applications during a higher method. A really common technique for image improvement is histogram equalization (HE) and curvelet transformation. HE technique is often utilized for image improvement owing to its simplicity and relatively higher performance on the majority forms of pictures. Another wide used technique is curvelet transformation. This system is known and separate bright regions of image however additional error rate and low Peak Signal to Noise Ratio (PSNR), result of this system is brightness preservation level is low and output image is grey [1].

Digital image process has several applications in several fields like medication, forensic, robotics, industrial automatic scrutiny systems, navigation etc. This field has attracted attentions of researchers and students to develop and/or to enhance algorithms for various applications [2]. With the event of image process techniques, individuals will simply tamper digital pictures by using some advanced

Author: e-mail: krishnaveni120691@gmail.com

software system. For pictures are wide used for the recent years, great amount of digital image manipulation might be seen in magazine, Industry, Scientific Journals, Court Rooms, News etc. The tampered pictures can turn out nice impact, and hurt to the traditional order of the society. The way to build effectively forensics to the tampered pictures is changing into a hunt hotspot within the data security field. Wherever digital image forensics has emerged as a replacement analysis field that aims to reveal meddling in digital pictures detection forgery in digital pictures is a rising analysis field [6].

a) Thresholding

Thresholding could be a common image segmentation methodology that converts a gray-level image into a binary image. The choice of optimum thresholds has remained a challenge over decades [9]. Binarization (i.e., image thresholding) is wide used as a preprocess algorithmic rule in image analysis and understanding [17]. Image thresholding (or binarization) could be a basic kind of image segmentation capability [19]. In all ancient segmentation schemes, statically measured thresholds or primary points are wont to binarize pictures. Due to the variations in pictures characteristics, these techniques could generate high segmentation accuracy for a few pictures and low accuracy for different pictures. For many pictures, the quantity of grey level is way smaller than the quantity of pixels [15]. Intelligent segmentation by "dynamic" determination of thresholds supported image properties is also a lot of sturdy answer [18].

Thresholding is a crucial method in several image process applications [10] [13]. However, the execution time needs should still be important, particularly if it's of interest to perform period of time thresholding of an outsized variety of pictures, like within the case of high-resolution video sequences [10]. The image thresholding drawback is treated as a crucial issue in image process, and it can not only reduce the image data, however additionally lay a decent foundation for succedent target recognition and image sympathetic. Nature of global thresholding segmentation and local thresholding was analyzed in image segmentation [8] [14]. In image analysis, image thresholding that is employed for separating the object from the background is one in every of the foremost common application. For the preprocessing functions of a picture, thresholding could be a necessary tool [16] [18].

Automatic thresholding is a very important technique within the image segmentation method. The essential plan of automatic thresholding is to mechanically choose an optimal gray-level threshold value for partitioning pixels within the pictures into object and background supported their gray-level distribution [12]. Entropy-based image thresholding has received wide interest in recent years. It's a very important concept within the space image segmentation. The entropy-based approach was wont to get the brink of image from eighty ages; it's wont to weight the quantity of reserved data of image once segmentation [11]. Thresholding segmentation may be a vital preprocessing tread on several image process applications. However, most of the prevailing thresholding ways will solely cope with a picture with some special histogram patterns [13].

Examples of thresholding applications are document image analysis wherever the goal is to extract written characters [26], [27] logos, graphical content, musical scores, map process wherever lines, legends, characters are to be found [28], scene process wherever a target is to detected [29], quality examination of materials [30], [31]. Alternative applications embrace cell pictures [32], [33] and data illustration [34], segmentation of assorted image modalities for non-destructive testing (NDT) applications, like ultrasonic pictures in [35], eddy current pictures [36], thermal pictures [37], X-raying computed tomography (CAT) [38], optical device scanning confocal research [38], extraction of edge field [39], image segmentation normally [40], [41] spatio-temporal segmentation of video pictures [42] etc.

II. Literature Review

Despite a lots of works out there within the literature, a handful of important explore works are reviewed here. In recent years, the outstanding advances in medical imaging instruments have enlarged their use significantly for medical specialty likewise as designing and follow-up of treatment [20]. Thresholding is that the simplest technique of image segmentation. From a grayscale image, thresholding is wont to produce binary pictures (Shapiro, et al. 2001:83) [21].

Martin Luessi et al.. discussed image thresholding could be a quite common image process operation, since the majority image process schemes would like some style of separation of the pixels into totally different categories. So as to work out the thresholds, most ways analyze the histogram of the image. The optimum thresholds are usually found by either minimizing or maximizing an objective function with reference to the values of the thresholds. By process two categories of objective functions that the optimum thresholds may be found by efficient algorithms [22].

Bong Chin-Wei et al analyses thresholding may be a common region segmentation technique. During this technique a threshold is chosen, and a picture is split into collections of pixels having value but the threshold and collections of pixels with values bigger or adequate to the brink. In 2007, Nakid and his team have planned to use the multi-objective approach to find the optimal thresholds of three criteria: the within-class criterion, the entropy and therefore the overall chance of error criterion [23].

There are varieties of survey papers on thresholding. Lee, Chung, and Park [44] conducted a comparative analysis of five global thresholding techniques and advanced helpful criteria for thresholding performance analysis. In an earlier work, Weszka and Rosenfeldcon jointly outlined many analysis criteria [45]. Palumbo, Swaminathan and Srihari addressed the problem of document binarization compares three techniques; whereas Trier and Jain had for most in depth comparison basis techniques in the context of character segmentation from complicated backgrounds [46]. Sahoo et al analyses nine thresholding algorithms and illustrated relatively their performance [47]. Glasbey have introduced the relationships and performance variations between eleven histogram-based algorithms supported an in depth statistical study [48].

Kapur et al (1985) employed the Global entropic thresholding algorithm. Unsupervised thresholding progress wherever the most excellent thresholding grey level is chosen by exhaustive search among obtainable grey intensities has been improved. One of the approach examined by the author is the make use of signal dispensation methods specifically thresholding and information fusion to recover the correctness of information mined from the restructured tomograms (Mwambela & Johansen 2001, Mwambela 1999, Mwambelaet al1997) [24]. Murthy et al have demonstrated the use of fuzzy and rough set theories to grip the vagueness there in pictures whereas performing histogram thresholding. Pal et al in the year 1983 established make use of the concept of decreasing fuzziness measures, which enumerate vagueness in information to achieve image segmentation based on histogram thresholding [25].

Solihin and Leedham have developed a global thresholding technique to extract written components from low-quality documents [59]. In an additional motivating approach Aviad and Lozinskii [60] have pioneered semantic thresholding to emulate human approach to image binarization. The "semantic" threshold is found by minimizing measures of conflict criteria in order that the binary image resembles most to a "verbal" description of the scene. Gallo and Spinello [61] have developed a method for thresholding and iso-contour extraction via fuzzy arithmetic. Fernandez [62]has investigated the choice of a threshold in matched filtering applications within the detection of tiny target objects. During this application the Kolmogorov-Smirnov distance between the background and object histograms is maximized as a purpose of the threshold value.

Anderson, J. et al have propose a technique supported the graph cut thresholding method, that is all the same acceptable for hardware (FPGA) time period implementations. The image of the weld pool was processed employing a series of methods: image truncation, bi-level thresholding, median filter and edge detection. Recently, a bi-level image thresholding technique supported graph cut was projected. The technique provided thresholding results that were superior to those obtained with previous techniques. Moreover, the technique was computationally less complicated compared to different graph cut-based image thresholding approaches. However, the execution time necessities should still be vital, particularly if it's of interest to perform time period thresholding of about sized range of pictures, like within the case of high-resolution video sequences. [80].

Traditional best thresholding techniques are terribly computationally high once extended to multilevel thresholding for their thoroughly search mode. Thus their applications are restricted. One in every of the foremost well-liked techniques for image segmentation is understood as multilevel thresholding. Multilevel thresholding amounts to segmenting a gray-level image into many distinct regions. The most distinction between multilevel and binary thresholding, is that the binary thresholding outputs a two-color image, sometimes black and white, whereas the multilevel thresholding outputs a gray scale image within which a lot of details from the first image may be unbroken. Two major issues with utilizing the multilevel thresholding technique are: it's a time overwhelming approach, i.e., finding acceptable threshold values may take exceptionally long process time; process a correct range of thresholds or levels that may keep most of the relevant details from the first image may be a troublesome task [81].

III. Existing Image Thresholding Techniques

The output of the thresholding operation could be a binary image whose grey level of zero (black) can indicate a picturing element fit in to a print, legend, drawing, or target and a grey level of one (white) can indicate the background. Taxonomy of thresholding algorithms supported on the sort of knowledge used. We have a tendency to distinguish six classes, namely, thresholding algorithms supported the exploitation of 1) Histogram entropy data, 2) Histogram shape data, 3) Image attribute data like contours, 4) Clump of gray-level data, 5) Domestically adaptative characteristics, 6) Spatial data [43].

1. Histogram shape-based techniques wherever the peaks, valleys and curvatures of the ironed histogram are measured and analyzed.
2. Clustering-based techniques wherever the grey level samples are clustered in two components as

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

background and foreground (object) or alternately are measure shapely as two Gaussian distributions.

3. Entropy-based techniques lead to algorithms, as an example, that uses the entropy foreground-background regions, the cross-entropy between the first and binarized image etc.
4. Object attribute-based techniques search a measure of similarity between the gray-level and binarized pictures, like as fuzzy similarity, shape, edges, variety of objects etc.
5. The spatial techniques use the likelihood mass performs models taking under consideration correlation between pixels on a global scale.
6. Local techniques don't verify an only single value of threshold however adapt the threshold value relying upon the local image characteristics.

a) Histogram Shape-Based Thresholding Methods

This class of techniques achieves thresholding supported the form properties of the histogram. Essentially two most important peaks and an intervening valley is searched for using such tools because the protrusive hull of the histogram, or its curvature and 0 (zero) crossings of the wavelet elements. Alternative authors try and approximate the histogram via two-step functions or two-pole autoregressive smoothing.

Using a differencing operation on the ironed kernel, the histogram is characterized by the set S of peaks, that's the triplet of early, peaking and terminating zero-crossings on the peak detection signal: $S=[(e_i,m_i,s_i),\ i=1,..I$, wherever I is that the variety of peaks wanted. The particular variety of peaks obtained is reduced to I, that's two for binarization, by adjusting the support of the smoothing filter and a peak-merging criterion. For two-level illustration of a picture the threshold ought to be somewhere in between the primary early and therefore the second terminating zero crossing, that is [50]:

$$T_{opt}=\gamma e_1+(1-\gamma)s_2,\quad 0\le\gamma\le 1.$$

b) Clustering based thresholding methods

In this category of algorithms the grey level information undergoes a clump analysis with the amount of clusters being set to two. Alternately the grey level distribution is shapely as a combination of two Gaussian distributions representing, correspondingly, the background and foreground regions.

Otsu advised minimizing the weighted total of within-class variances of the foreground associated background pixels to determine an optimum threshold. Since step-down of within-class variances is equal to the maximization of between-class scatter, the selection of the optimum threshold may be developed as [51]:

$$T_{opt}=\arg\max[P(T).(1-P(T)).(m_f(T)-m_b(T))^2]$$

The Otsu technique provides satisfactory results once the numbers of pixels in every category are nearone other. The Otsu technique still remains one in every of the foremost documented thresholding techniques. During a similar study thresholding supported on isodata clump is given in Velasco [52]. Some limitations of the Otsu technique is mentioned in Lee [53].

c) Entropy based thresholding methods

This category of algorithms exploits the entropy of the distribution of the grey levels during a scene. The maximization of the entropy of the thresholded image is understood as indicative of most data transfer. Alternative authors try and minimize the cross-entropy between the input gray-level image and therefore the output binary image as indicative of preservation of data. Johannsen and Bille [54] and Pal, King, Hashim [55] were the primary to check Shannon entropy based mostly thresholding.

In this technique the foreground and background categories are thought about as two completely different sources. Once the total of the two category entropies may be a most the image is alleged to be optimally thresholded. Therefore using the description of the foreground and background entropies,

$$H_f(T)=-\sum_{g=0}^{T}\frac{p(g)}{P(T)}\log\frac{p(g)}{P(T)}\ \text{and}\ H_b(T)=-\sum_{g=T+1}^{G}\frac{p(g)}{P(T)}\log\frac{p(g)}{P(T)}\ \text{one has [56]:}$$

$$T_{opt}=\arg\max[H_f(T)+H_b(T)]$$

Yen, Chang and Chang [56] have thought about a multilevel thresholding method wherever additionally to the category entropies a cost purpose based on the amount of bits required to the thresholded image is enclosed.

d) Thresholding Algorithms Based on Attribute Similarity

The calculations considered under this class select the limit quality in light of some similitude measure between the first picture and the binarized adaptation of the picture. These characteristics can take the manifestation of edges, shapes, or one can specifically consider the first dim level picture to parallel picture similarity. Then again they consider certain picture properties, for example, reduction or integration of the items coming about because of the binarization process or the happenstance of the edge fields.

Hertz and Schafer [82] consider a multi thresholding method where a beginning global threshold assessment is refined provincially by

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

considering edge data. The system expect that a diminished edge field is gotten from the dim level picture E_{gray}, which is contrasted and the edge field got from the binarized picture, E_{binary} (T). The edge is balanced in such a path, to the point that the fortuitous event between theories two edge fields is expanded. This infers there is least stipend for both overabundance edges and missed edges. For our situation we have considered a streamlined adaptation of this methodology. Both the dark level picture edge field and the twofold picture edge field have been gotten through the Sobel administrator. The worldwide limit is given by that esteem that expands the occurrence of the two edge fields in light of the check of coordinating edges and punishing the overabundance unique edges and the abundance thresholded picture edges.

$$T_{opt} = \arg\max[E_{gray} \cap E_{binary}(T)]$$

In a corresponding study Venkatesh and Rosin [83] have identified the difficulty of best possible thresholding for edge field assessment.

e) Spatial thresholding methods

In this category of algorithms one utilizes spatial details of object and background pixels, for instance, within the sort of context possibilities, correlation functions, co-occurrence possibilities, local linear dependence models of pixels, two-dimensional entropy etc. One in the entire primary to explore spatial details was Rosenfeld [63] who thought about such ideas as local average grey level for thresholding. Alternative authors have used relaxation to improve on the binary map [64], [65], the Laplacian of the images to enhance histograms [49], the quad tree thresholding and second-order statistics [66]. Co-occurrence probabilities have been used as indicator of spatial dependence as in Lie [67], Pal [68], and Chang [69]. Recently Leung and Lam have thought about thresholding within the context of a posteriori spatial chance estimation [70].

Chanda and Majumder [71] had advised the employment of co-occurrences for threshold choice. Lie [67] has projected many measures to the present result. Within the technique by Chang, Chen, Wang and Althouse the co-occurrence possibilities of each the initial image and of the thresholded image are calculated. A suggestion that the thresholded image is most kind of like the initial image is obtained whenever they possess as similar co-occurrences as doable. In alternative words the threshold T is set in such a way that the grey level transition possibilities of the initial image has minimum relative entropy (discrepancy) with reference to that of the initial image. This assess of similarity is obtained by the relative entropy, as an alternative referred to as the directed divergence or the Kullback-Leibler distance, that for two generic distributions p, q has the shape $D(p,q) = \sum_{p,q} p \log \frac{p}{q}$.

Think about the four quadrants of the co-occurrence matrix: The primary quadrant denotes the background-to-background (bb) transitions whereas the third quadrant corresponds to the foreground-to-foreground (ff) transitions. Equally the second and fourth quadrants denote, correspondingly, the background-to-foreground (bf) and also the foreground-to-background (fb) transitions. Belongings the cell possibilities be denoted as p_{ij}, that is that the i to j grey level transitions normalized by the overall variety of transitions. The quadrant probabilities are obtained as: $P_{bb}(T) = \sum_{i=0}^{T}\sum_{j=0}^{T} p_{ij}$, $P_{bf}(T) = \sum_{i=0}^{T}\sum_{j=T+1}^{G} p_{ij}$, $P_{ff}(T) = \sum_{i=T+1}^{G}\sum_{j=T+1}^{G} p_{ij}$, $P_{fb}(T) = \sum_{i=T+1}^{G}\sum_{j=0}^{T} p_{ij}$ and equally for the thresholded image one finds the quantities Q_{bb}(T), Q_{bf}(T), Q_{ff}(T), Q_{fd}(T). Plugging these expressions of co-occurrence possibilities within the relative entropy expression one will establish an optimum threshold as [69]:

$$T_{opt} = argmin[P_{bb}(T)logQ_{bb}(T) + P_{bf}(T)logQ_{bf}(T) + P_{ff}(T)logQ_{ff}(T) + P_{fb}(T)logQ_{fb}(T)]$$

$$T(i,j) = m(i,j) + [1 + k.(\frac{\sigma(i,j)}{R} - 1)]$$

f) Locally adaptive thresholding strategies

A threshold that's calculated at every picture element characterizes this category of algorithms. The worth of the threshold depends upon some narrow statistics like vary, variance, and surface fitting parameters or their logical mixtures. It's typical of domestically adaptive strategies to own many adjustable parameters [72]. The threshold T (i, j) are going to be indicated as a purpose of the coordinates i, j; otherwise the thing or background selections at every picture element are going to be indicated by the logical variable B (i, j). Nakagawa and Rosenfeld [73], Deravi and Pal [74] were the first users of adaptive techniques for thresholding.

This technique claims to recover on the Niblack technique particularly for stained and badly well-lighted documents. It adapts the threshold according to the local mean and variance over a window size of bxb. The threshold at picture element (i,j) is calculated as:

where m(i,j) and $\sigma(i,j)$ are as in Niblack [59] and

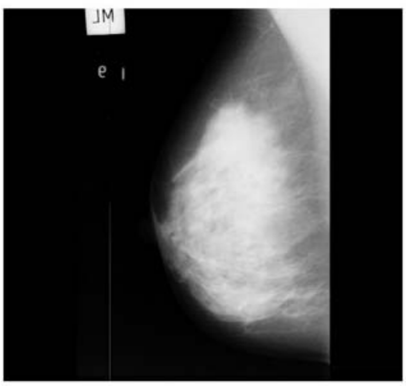
Sauvola suggests the values of k = 0.5 and R = 128. Therefore the contribution of the standard deviation is converted into adaptive. For instance within the case of text written on a grimy or stained paper the threshold is down [75].

Among different local thresholding strategies specifically meshed to document pictures one will mention the work of Kamada and Fujimoto [76]who develop a two-stage technique, the primary being a global threshold, followed by a neighborhood refinement. Eikvil, Taxt and Moen [77] think about a quick adaptive technique for binarization of documents whereas Pavlidis [78] uses the second-derivative of the gray-level image. Zhao and Ong [79] have thought about validity-guided fuzzy c-clustering to supply thresholding strong against illumination and shadow effects.

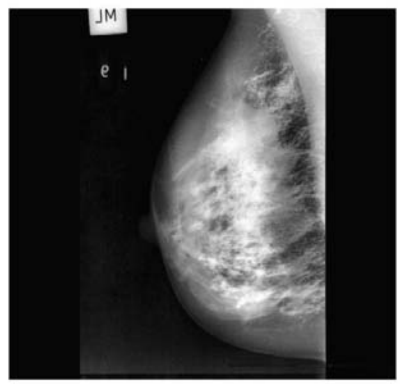
IV. Results and Discussion

NORMAL Mammogram images of (Mdb003)

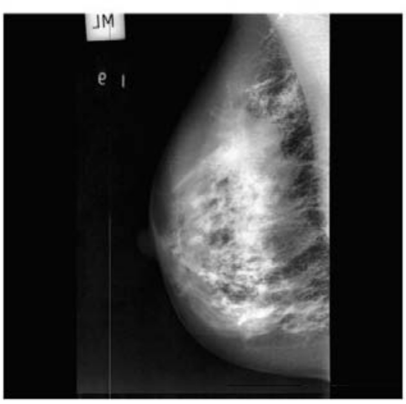
Histogram Shape based methods



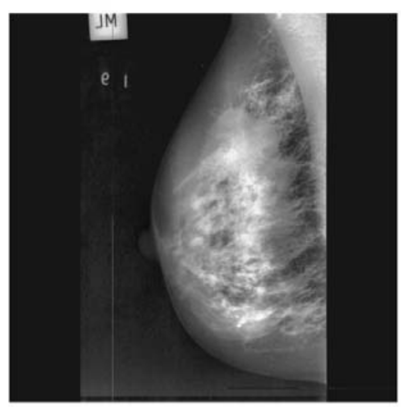
(a) Mdb003 — Original Image



(b)Mdb003 'Uniform'— Flat histogram



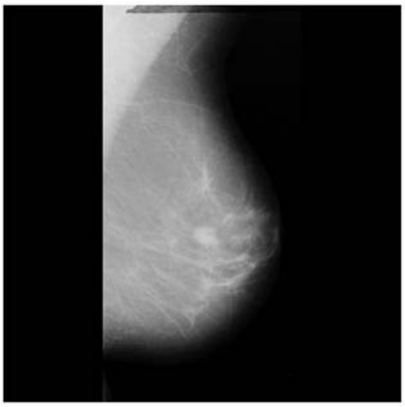
(c) Mdb003 'Rayleigh' — Bell-shaped histogram



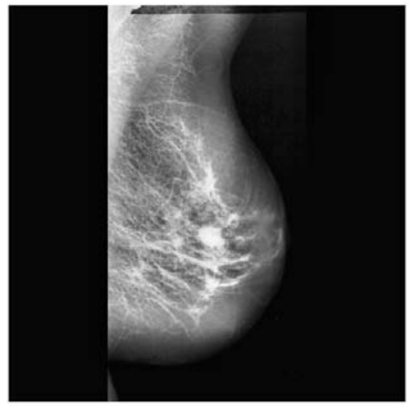
(d) Mdb003'Exponential' — Curved histogram

BENIGN Mammogram images of (Mdb010)

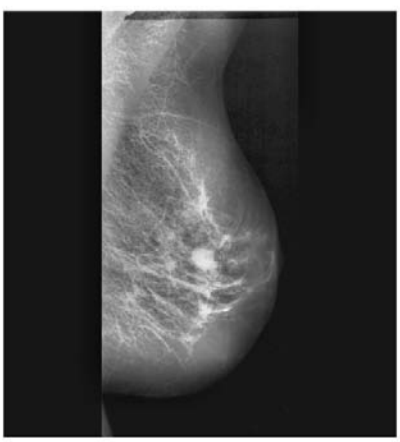
Histogram Shape based methods



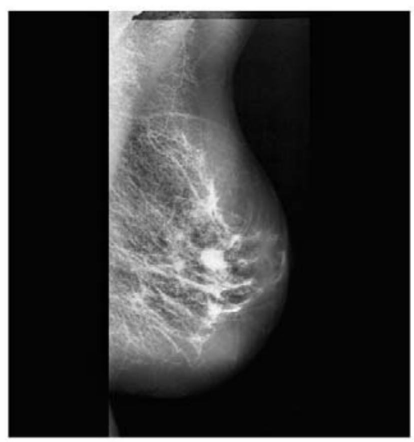
(a) Mdb010— Original Image



(b)Mdb010'Uniform'— Flat histogram



(c) Mdb010'Rayleigh' — Bell-shaped histogram

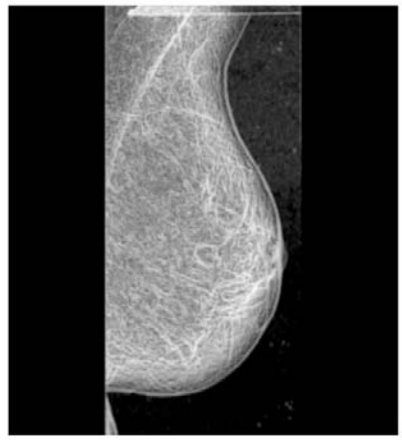


(d)Mdb010 'Exponential' — Curved histogram

Mammogram images of (Mdb003), (Mdb010) and (Mdb058)

Entropy based methods

(a) Mdb003 — Entropy based



(b) Mdb010 — Entropy based

(c) Mdb058 — Entropy based

Mammogram images of (Mdb003), (Mdb010) and (Mdb058)

Spatial based methods

(a) Mdb003 — Spatial based

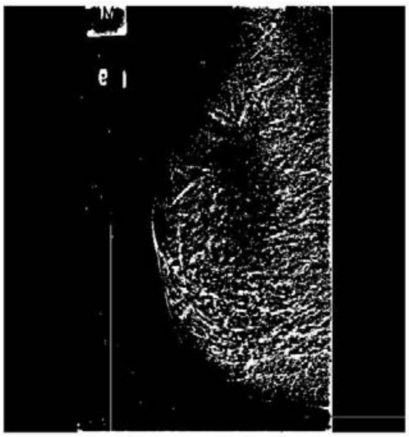
(b)Mdb010 — Spatial based

(c)Mdb058 — Spatial based

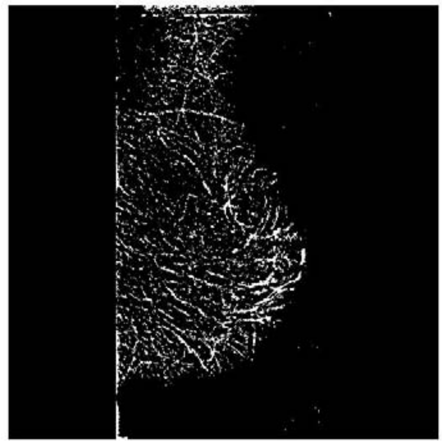
Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

Mammogram images of (Mdb003), (Mdb010) and (Mdb058)

Locally Adaptive based methods



(a) Mdb003 — Locally Adaptive based



(b)Mdb010 — Locally Adaptive based

(c)Mdb058 — Locally Adaptive based

V. Examinations

Beside an unpleasant portrayal of every system, we introduce a valuable measurement and exchanges about the recurrence of the most utilized picture transforming techniques as a part of the issue of tiny picture division. This investigation is useful for a superior utilization of existing systems, for enhancing their execution and in addition for outlining new ones. Table 1 demonstrates the most essential image thresholding systems found in the considered papers.

Author Name	Year	Domain	Model	Applications
Bamford and Lovell	1998	Cell Segmentation	Level set methods	Biological images
Solorzano et al.,	1999	Networking	World Wide Lightning Location Network (WWLN)	Lightning data for hurricanes
Cong and Parvin	2000	Segmentation and Classification	Image analysis techniques (the geometrical model fitting)	Cellular images
Boland and Murphy	2001	Pattern classification	Interpretation the concavity points	Microscope images
Malpica and de Solorzano	2002	Segmentation	Grey Level thresholding	Cellular images
Hu, et al.,	2004	segmentation	improved active contour model	Cell images.
Wahlby, et al.,	2004	segmentation	watershed segmentation	Cell images.
Naik, et al.,	2007	segmentation	Bayesian classifier and a level-set	Medical images
Lebrun et al.,	2007	segmentation	support vector machine (SVM)	Cellular images
Colantonio et al.,	2007	segmentation	fuzzy c-means algorithm	Medical image
Yang et al.,	2005	segmentation	gradient vector	Color images
Nilsson &Heyden,	2005	segmentation	level set methods and the watershed	Bone marrow sample images
Wang, et al.,	2008	Segmentation	Adaptive thrsholding algorithm	Leaf images
Angulo	2008	Segmentation	watershed segmentation and thresholding	Light channel image
Bai, et al.,	2009	Segmentation	Thresholding	MRI brain images
Coelho, et al.,	2009	Segmentation	watershed	Microscope Cell images
Dalle, et al.,	2009	Histopathology Image Segmentation	Thresholding	Histopathological H & E Stained Breast Cancer Images
Danek et al.,	2009	segmentation	graph-cut	Cellular images
Russell, et al.,	2009	segmentation	Stable Count *Thresholding* (SCT)	Cellular images
Ta, et al.,	2009	segmentation	Otsu's method	fluorescence microscopic images
Zhou,et al.,	2009	segmentation	The adaptive thresholding and watershed, Markov model.	Satellite imagery
Jeong, et al.,	2009	Classification	Thresholding	Microscopy images.
(Yang &Choe,	2009)	segmentation	graph-cut	Microscopy images.
Xiangzhi,et al.,	2009	Edge detection	Thresholding	Real time images
Madhloom,et al.,	2010	segmentation	The adaptive thresholding	Cellular images
Wei,et al.,	2011	segmentation	Renyi entropy thresholding	3-d images
Seroussi,et al.,	2012	Segmentation	Modified active contour model	Microscopy images
Ali El-Zaart and Ali A.Ghosn	2013	Segmentation	Bimodal and multimodal thresholding	MRI Brian images

Jin LIU	2014	Segmentation	3-d histogram based thresholding method	Two synthetic aperture radar (SAR) images and two license plate images
Temitope Mapayi et al.,	2015	Retinal Vessel Segmentation	Adaptive Thresholding Technique	Retinal image
James R. Parker	2015	Segmentation	Gray level thresholding	Various areas of the image
Akshay Upadhyay and Ramgopal Kashyap	2016	Segmentation	Intensity and Texture Based Segmentation	Medical Image
Murat Karakoyun et al	2017	Segmentation	Multilevel Thrsholding using Otsu's method	Real Images
K.P.Baby Resma et al..	2018	Segmentation	Multilevel Thrsholding using Kapur and Otsu technique	Real Images
Hemeida, A. M.et al.,	2019	Segmentation	Multilevel Thrsholding	Standard Test Images

As pointed out in [Malpica and de Solorzano, 2002], the most widely spread segmentation method is grey level thresholding.

VI. Conclusions

Since there is no general methodology for getting precise picture segmentation, pretty much all systems consolidate the two fundamental methodologies: region based plans and edge based plans. This is way a characterization taking into account the paradigm utilized by every segmentation procedure is practically inconceivable. Rather, a rundown of the most utilized routines and how they are normally joined to accomplish great segmentation results is useful for better utilization of existing strategy and for enhancing their execution and in addition for planning new ones. In this paper we generally depict some illustrative studies in the field of thresholding for picture segmentation. Some of them utilize just basic transforming methods yet the larger part consolidates techniques without considering their multifaceted nature, e.g. edge with molecule calculation (Wang et al., 2008) or fuzzy c-means calculation with manufactured neural system (Colantonio et al., 2007). As a general propensity we can presume that the new systems utilize two principle headings which appear to give steady and precise segmentation results. The first has a tendency to utilize the geometrical properties as from the earlier information, i.e. geometrical model fitting. At the point when this is unrealistic because of powerless limits, low between item complexities or high variability fit as a fiddle and size, the second inclination taking into account items gimmicks is viewed as; these peculiarities are utilized to prepare an ANN, a Bayesian systems or a SVM.

References Références Referencias

1. Rosenfeld, R. Smith, Thresholding Using Relaxation, IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI-3 (1981) 598-606.
2. A. D. Brink, Minimum spatial entropy threshold selection, IEE Proeeding of Vis. Image Signal Processing, 142 (1995) 128-132.
3. A. D. Brink, N. E. Pendock, Minimum Cross Entropy Threshold Selection, Pattern Recognition, 29 (1996) 179-188.
4. Ahirwar, V. ; Yadav, H. ; Jain," A. Hybrid model for preserving brightness over the digital image processing" Computer and Communication Technology (ICCCT), 2013 4th International Conference on Page(s): 48 – 53.
5. Al-Ghaib, H. ; Adhami, R. "An E-learning interactive course for teaching digital image processing at the undergraduate level in engineering" Interactive Collaborative Learning (ICL), 2012 15th International Conference on Page(s): 1 - 5.
6. Anderson, J.; Gundam, M.; Joginipelly, A.; Charalampidis, D. "FPGA implementation of graph cut based image thresholding "2012, Page(s):88-93System Theory (SSST).
7. Anderson, J.; Gundam, M.; Joginipelly, A.; Charalampidis, D."FPGA implementation of graph cut based image thresholding" System Theory (SSST), 2012 44th Southeastern Symposium on Page(s): 88 - 93.

8. Arifin, A. Z.; Heddyanna, A. F.; Studiawan, H. “Image thresholding using ultra fuzziness optimization based on type II fuzzy sets” Instrumentation, Communications, Information Technology, and Biomedical Engineering (ICICI-BME), 2009 International Conference on Page(s):1-6
9. Bhanu, Automatic Target Recognition: State of the Art Survey, IEEE Transactions on Aerospace and Electronics Systems, AES-22 (1986) 364-379.
10. Chanda, D. D. Majumder, A note on the use of gray level co-occurrence matrix in threshold selection, Signal Processing, 15 (1988) 149-167.
11. Bong Chin-Wei and Mandava Rajeswari, “Multiobjective optimization approaches in image segmentation-the directions and challenges”, Int. J. Advance. Soft Comput. Appl., Vol.2, No.1, March 2010.
12. Chang, K. Chen, J. Wang, M. L. G. Althouse, A Relative Entropy Based Approach in Image Thresholding, Pattern Recognition, 27 (1994) 1275-1289.
13. C. A. Glasbey, An analysis of histogram-based thresholding algorithms, Graphical Models and Image Processing, 55 (1993) 532-537.
14. C. K. Leung, F. K. Lam, Maximum a Posteriori Spatial Probability Segmentation, IEE Proc. Vision, Image and Signal Proc., 144 (1997) 161-167.
15. Chen, T.; Takagi, M. “Run length coding based new approach to automatic image thresholding” Circuits and Systems, 1993., ISCAS '93, 1993 IEEE International Symposium on Page(s): 555 - 558 vol.1
16. Corson, M. S. ; Moss, R. H. “Computer vision: An in-depth look at the technique and applications of digital image processing” 1986, Volume: 5 , Issue: 4 Page(s): 31 – 34.
17. Deravi, S. K. Pal, Grey level thresholding using second-order statistics, Pattern Recognition Letters, 1 (1983) 417-422.
18. F. R. D. Velasco, Thresholding using the Isodata Clustering Algorithm, IEEE Trans. System Man and Cybernetics, SMC-10 (1980) 771-774.
19. Fekete, J. O. Eklundh, A. Rosenfeld, Relaxation: Evaluation and Applications, IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI-3 No. 4 (1981) 459-469.
20. Gallo, S. Spinello, Thresholding and fast iso-contour extraction with fuzzy arithmetic, Pattern Recognition Letters, 21 (2000) 31-44.
21. Johannsen, J. Bille, A threshold selection method using information measures, ICPR'82: Proc. 6th Int. Conf. Pattern Recognition, Berlin, 1982, pp: 140-14.
22. Gonzalez, Rafael C. & Woods, Richard E. (2002). Thresholding. In Digital Image Processing, pp. 595–611. Pearson Education. ISBN 81-7808-629-8.
23. Guang Yang, Kexiong Chen, Maiyu Zhou, ZhonglinXu, Yongtian Chen, “Study on Statistics Iterative Thresholding Segmentation Based on Aviation Image” Software Engineering, Artificial Intelligence, Networking, and Parallel/Distributed Computing, 2007, IEEE Transactions on Volume: 2.
24. Kamada, K. Fujimoto, High-speed, high-accuracy binarization method for recognizing text in images of low spatial resolution, ICDAR’99, Int. Conf. On Document Analysis and Recognition, Ulm, Germany, (1999), pp: 139-142.
25. H. Lee, R. H. Park, Comments on an optimal threshold scheme for image segmentation, IEEE Trans. System, Man and Cybernetics, SMC-20 (1990) 741-742.
26. Isaac Bankman, Published: September 2000 ,Imprint: Academic Press ISBN: 978-0-12-077790-7 “Handbook of Medical Imaging Processing and Analysis Management”
27. Fan, J. Yu, G. Fujita, T. Onoye, L. Wu, I. Shirakawa, Spatiotemporal segmentation for compact video representation, Signal Processing: Image Communication, 16 (2001), 553-566.
28. Moysan, G. Corneloup, T. Sollier, Adapting an ultrasonic image threshold method to eddy current images and defining a validation domain of the thresholding method, NDT&E International, 32 (1999) 79-84.
29. J. Sauvola, M. Pietaksinen, Adaptive document image binarization, Pattern Recognition, 33 (2000) 225-236.
30. J. Weszka, A. Rosenfeld, Histogram Modification for Threshold Selection, IEEE Trans. System, Man and Cybernetics, SMC- 9 (1979) 38-52.
31. J. C. Russ, Automatic discrimination of features in gray-scale images, Journal of Microscopy, 148(3) (1987) 263-277.
32. J. C. Yen, F. J. Chang, , S. Chang, A new criterion for automatic multilevel thresholding, IEEE Trans. on Imag Processing, IP-4 (1995) 370-378.
33. J. N. Kapur, P. K. Sahoo, A. K. C. Wong, A New Method for Gray-Level Picture Thresholding Using the Entropy of the Histogram,” Graphical Models and Image Processing, 29 (1985) 273-285.
34. J. S. Chang, H. Y. M. Liao, M.K. Hor, J. W. Hsieh, M.Y. Chern, New Automatic Multi-level Thresholding Technique for Segmentation of Thermal Images, Image Vision and Computing, 15 (1997) 23-34.
35. J. S. Weszka, A. Rosenfeld, Threshold evaluation techniques, IEEE Trans. Systems, Man and Cybernetics, SMC-8(8) (1978) 627-629.
36. Janakiraman, S. ; Daniel, J. ; Abudhahir, A. “Certain studies on thresholding based defect detection algorithms for Magnetic Flux Leakage images “Emerging Trends in Computing, Communication and Nanotechnology (IGE CCN), 2013 Page (s): 507-512.

37. Juxia Ma , "Based on the fourier transform and the wavelet transformation of the digital image processing" Page(s): 1232 – 1234.
38. Eikvil, T. Taxt, K. Moen, A fast adaptive method for binarization of document images, ICDAR'91, Int. Conf. On Document Analysis and Recognition, St. Malo, (1991), pp: 435-443.
39. L. U. Wu, M. A. Songde, L. U. Hanqing, "An Effective Entropic Thresholding for Ultrasonic Imaging, ICPR'98: Int. Conf. on Pattern Recognition, Australia, 1998 pp: 1522-1524.
40. Lulu Fang ; YaobinZou ; Fangmin Dong ; Shuifa Sun ;Bangjun Lei"Image thresholding based on maximum mutual information" Image and Signal Processing (CISP), 2014 7th International Congress on 2014 , Page(s): 403 - 409.
41. Sezgin, B. Sankur, Comparison of thresholding methods for non-destructive testing applications, accepted for IEEE ICIP'2001, International Conference on Image Processing, Thessaloniki, Greece October 7-10, 2001.
42. Sezgin, B. Sankur, Image Thresholding Techniques: Quantitative Performance Evaluation, submitted to Pattern Recognition , 2001.
43. M. Sezgin, R. Tasaltin, A new dichotomization technique to multilevel thresholding devoted to inspection applications, Pattern Recognition Letters, 21 (2000) 151-161.
44. M. E. Sieracki, S. E. Reichenbach, K. L. Webb, Evaluation of automated threshold selection methods for accurately sizing microscopic fluorescent cells by image analysis, Applied and Environmental Microbiology, 55 (1989) 2762-2772.
45. M.I. Sezan, A Peak Detection Algorithm and its Application to Histogram-Based Image Data Reduction, Graphical Models and Image Processing, 29 (1985) 47-59.
46. M. Kamel, A. Zhao, Extraction of Binary Character/Graphics Images From Grayscale Document Images, Graphical Models and Image Processing, 55, No.3 (1993) 203-217.
47. Mahmoudi, L.; El Zaart, A. "A survey of entropy image thresholding techniques "Advances in Computational Tools for Engineering Applications (ACTEA), 2012 ,Page(s): 204 - 209.
48. Martin Luessi; Marco Eichmann; Guido M. Schuster ; Aggelos K. Katsaggelos "Framework foe efficient optimal multilevel image thresholding", J. Electron. Imaging. 2009.
49. Ming Zeng ; Tiemao Han ; QinghaoMeng ; ZhengbiaoBai ; Zhengcun Liu, "Image thresholding based on edge information analysis" Image and Signal Processing (CISP), 2012 5th International Congress on Page(s): 1371 - 1375.
50. Murthy, C. A, Pal, S. K,"histogram thresholding by minimizing graylevel fuzziness, Information Sciences, 60(1-2), 1992, 107-135.
51. Ahuja, A. Rosenfeld, A Note on the Use of Second-Order Gray-Level Statistics for Threshold Selection, IEEE Trans. Systems Man and Cybernetics, SMC-5 (1975) 383-388.
52. N. Otsu, A Threshold Selection Method From Gray Level Histograms, IEEE Transactions on Systems, Man, and Cybernetics, SMC-9 (1979) 62-66.
53. N. R. Pal, S. K. Pal, Entropic Thresholding, Signal Processing, 16 (1989) 97-108.
54. O. D. Trier, A. K. Jain, Goal-directed evaluation of binarization methods, IEEE Tran. Pattern Analysis and Machine Intelligence, PAMI-17 (1995) 1191-1201.
55. Othman, A. A.; Tizhoosh, H. R."Neural image thresholding with SIFT-Controlled gabor features" Neural Networks (IJCNN), The 2011 International Joint Conference on 2011 , Page(s): 2106 - 2112.
56. Bock, R. Klinnert, R. Kober, R. M. Rovner, H. Schmidt, "Gray-scale ALIAS", IEEE Trans. on Knowledge and Data Processing, 4 (1992) 109-122.
57. P. K. Sahoo, S. Soltani, A. K. C. Wong , Y. Chen., A Survey of Thresholding Techniques, Computer Graphics and Image Process., 41 (1988) 233-260.
58. P. W. Palumbo, P. Swaminathan, S. N. Srihari, Document image binarization: Evaluation of algorithms, Proc. SPIE Applications of Digital Image Proc., SPIE Vol. 697, (1986), pp:278-286.
59. Perez, T. Pavlidis, An iterative thresholding algorithm for image segmentation, IEEE Trans. Pattern Analysis and Machine Intelligence, PAMI-9 (1987) 742-751.
60. Kohler, A segmentation system based on thresholding, Graphical Models and Image Processing, 15 (1981) 319-338.
61. R. L. Kirby, A. Rosenfeld, A Note on the Use of (Gray Level, Local Average Gray Level) Space as an Aid in Threshold Selection, IEEE Trans. Systems, Man and Cybernetics, SMC-9 (1979) 860-864.
62. Venkatesh, P. L. Rosin, Dynamic Threshold Determination by Local and Global Edge Evaluation, CVGIP: Graphical Models and Image Processing, 57 (1995) 146-160.
63. S. K. Pal, R. A. King, A. A. Hashim, Automatic Gray Level Thresholding Through Index of Fuzziness and Entropy, Pattern Recognition Letters, 1 (1980) 141-146.
64. S. U. Le, S. Y. Chung, R. H. Park, A Comparative Performance Study of Several Global Thresholding Techniques for Segmentation, Graphical Models and Image Processing, 52 (1990) 171-190.
65. Saha, P. K., Udupa, J. K. "Optimum image thresholding via class uncertainty and region homogeneity" Pattern Analysis and Machine Intelligence, 2001, IEEE Transactions on Volume: 23 , Issue: 7.
66. Salim, S. R. ; Salman, H. M. ; Al-Wakeel , "Fuzzy gradient based image reconstruction as a means

for detection the tampering"Computer Science and Electronic Engineering Conference (CEEC), 2014, Page(s): 73 – 78.

67. Sohi, D. S.; Devgan, S. S. "Application to enhance the teaching and understanding of basic image processing techniques" Southeastcon 2000. Proceedings of the IEEE Page(s): 413 - 416.
68. Pavlidis, Threshold selection using second derivatives of the gray-scale image, ICDAR'93, Int. Conf. On Document Analysis and Recognition, South Korea, (1993), pp: 274-277.
69. T. Abak, U. Barış B. Sankur, The Performance of Thresholding Algorithms for Optical Character Recognition, Int. Conf. on Document Analysis and Recognition: ICDAR'97, Ulm., Germany, 1997, pp:697-700.
70. Vajda, F. "Techniques and trends in digital image processing and computer vision" Mathematical Modelling and Simulation of Industrial and Economic Processes, IEE Colloquium on 1994.
71. W. Oh, B. Lindquist, Image thresholding by indicator kriging, IEEE Trans. Pattern Analysis and Machine Intelligence, PAMI-21 (1999) 590-602.
72. W.N. Lie, An efficient threshold-evaluation algorithm for image segmentation based on spatial gray level co-occurrences, Signal Processing, 33 (1993) 121-126.
73. Wenbing Tao ; Hai Jin ; Yimin Zhang ; Liman Liu ; Desheng Wang" Image Thresholding Using Graph Cuts" Systms, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on Volume: 38 , Issue: 5 Page(s):1181 - 1195.
74. X. Fernandez, Implicit model oriented optimal thresholding using Kolmogorov-Smirnov similarity measure, ICPR'2000: Int. Conf. Pattern Recognition, Barcelona, 2000.
75. X. Zhao, S. H. Ong, Adaptive local thresholding with fuzzy-validity guided spatial partitioning, ICPR'98, Int. Conf. on Pattern Recognition, Barcelona, (1998), pp:988-990.
76. Y. Nakagawa, A. Rosenfeld, Some experiments on variable thresholding, Pattern Recognition, 11(3) (1979) 191-204.
77. Y. Solihin, C. G. Leedham, Integral ratio: A new class of global thresholding techniques for handwriting images, IEEE Trans Pattern Recognition and Machine Intelligence, PAMI-21 (1999) 761-768.
78. Y. Yasuda, M. Dubois, T. S. Huang, Data Compression for Check Processing Machines, Proceeding of IEEE, 68 (1980) 874-885.
79. Yumusak, N.; Temurtas, F.; Çerezci, O.; Pazar, S."Image thresholding using measures of fuzziness" Industrial Electronics Society, 1998. IECON '98. Proceedings of the 24th Annual Conference of the IEEE ,Volume:3,Page(s):1300-1305.
80. Yun-Chia Liang ; Cuevas J, J. R.," Multilevel image thresholding using relative entropy and Virus Optimization Algorithm" Evolutionary Computation (CEC), 2012 IEEE Congress on Page(s): 1 - 8.
81. Z. Aviad, E. Lozinskii, Semantic thresholding, Pattern Recognition Letters, 5 (1987) 321-328.
82. L.Hertz,R.W.Schafer,"Multilevel thresholding using edge matching",Computer vision graphics and image processing,44 (1988) 279-295.
83. S. Venkatesh, P. I. Rosin, threshold determintion by local and global edge evaluation, CVIP: Graphical m-odels and image processing, 57 (1995) 146-160.
84. https://www.baslerweb.com/en/vision-campus/vision-systems-and-components/imageprocessing-systems/
85. Krishnaveni A, Shankar R and Duraisamy S "A Survey on Nature-Inspired Computing (NIC): Algorithms and Challenges" Global Journal of Computer Science and Technology: D Neural & Artificial Intelligence Volume 19 Issue 3 Version 1.0 Year (2019).

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

This page is intentionally left blank

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 21 Issue 1 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Computer Generation of Fractals Some Methods and Techniques

By Poli Venkata Subba Reddy
Sri Venkateswara University

Abstract- Fractals are objects, have the property of a system scale invariance or self-similarity. These objects are accursed in nature in the form of cost, hills, clouds, and waling act. These structures are need computer assistance for a generation. In this paper, the fractal dimensions were studied. Some methods and techniques are studied to simplify the Computer generation of fractals. Python programming is given to generate fractal graphics.

Keywords: fractals, fractal generation, fractal dimension, iteration, recursion, parallelism, python.

GJCST-F Classification: *I.3.6*

Computer Generation of Fractals Some Methods and Techniques

Poli Venkata Subba Reddy

Abstract- Fractals are objects, have the property of a system scale invariance or self-similarity. These objects are accursed in nature in the form of cost, hills, clouds, and waling act. These structures are need computer assistance for a generation. In this paper, the fractal dimensions were studied. Some methods and techniques are studied to simplify the Computer generation of fractals. Python programming is given to generate fractal graphics.

Keywords: fractals, fractal generation, fractal dimension, iteration, recursion, parallelism, python.

I. Introduction

Fractal structures of nature [1] are similar to themselves on different length-scales of observation. This geometrical property is studied for a great variety of irregular shapes, many of which result from the growth process.

Fractals geometry is introduced by Mandelbrot [l} as" the Geometry of Nature". Clouds are not spheres, mountains are not cones, coastlines are not circles and nor does lightning travel in a straight line, says Dr. Beroit Mandelbrot.

Human expertise is not sufficient to generate Fractals of nature. Fractals need computer assistance. Even Computer programming also requires methods and techniques to generate fractals. In the following, some methods and techniques are proposed for Computer generation of fractals.

II. Fractals and Dimension

Fractal is defined as similar to themselves of geometrical shapes. For instance, coastlines, mountains, rivers, etc. The fractal structures are studied through the fractal dimension and defined by

$$D = \log N(h)/\log(1/h)$$

Where h is the length of line-segment and N(h) is the number of line-segments.

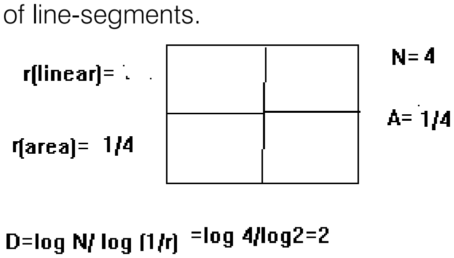


Figure 1: Fractal scaling

Author: Department of Computer Science and Engineering, College of Engineering, Sri Venkateswara University, Tirupati, India.
e-mail: pvsreddy@hotmail.co.in

III. Methods and Techniques

Computer generation of fractal shell be simplified by introducing methods and techniques. In the following, three methods and techniques are introduced to simplify the complexity of Computer generation of fractals.

a) *Iteration*

Iteration is the method in which output function value may be taken an input value to the function. This method is proposed to reduce the complexity of Computer generation of fractals.

This is given by

$$n = f(n)$$

For instance, N
1
2
4

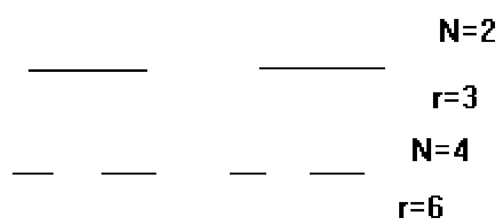


Figure 2: Iteration

$$D== \log(2/3) = 0.63\ 09$$

Here, the number of self similarities can be defined as N = f(N).

b) *Recursion*

Recursion is a process that calls itself, directly or indirectly. This method can be applied to simplify the complexity of Computer generation of fractals using programming.

For instance, consider the generation of the Koch curve. The recursion method is applied to call self-similarity.

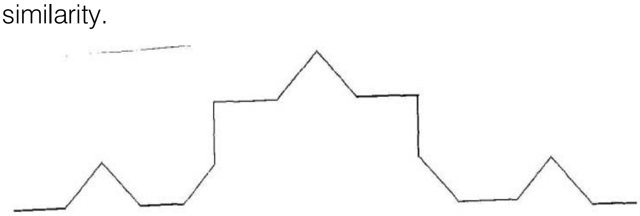


Figure 3: Recursion

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

D=log 4/log 3 = log 16/log 9=.26

c) Parallel fractals

The parallel processing technique is divide number of sub-task of the task and each task will processed independently with individual processors in the Multiprocessing computer system. This parallel processing technique is proposed for Computer generation of fractals when the large number of computations and having the number of sub-tasks. The computer generation of fractals, in which the fractal can be divides into the number of sub-tasks, and each sub-task will be processed with independent processor and generate the self-similarities.

For instance, consider the Sierpinski gasket in which the triangle is divided into three triangles and each triangle will self-similarly generate with independent processor in Multiprocessing computer system.

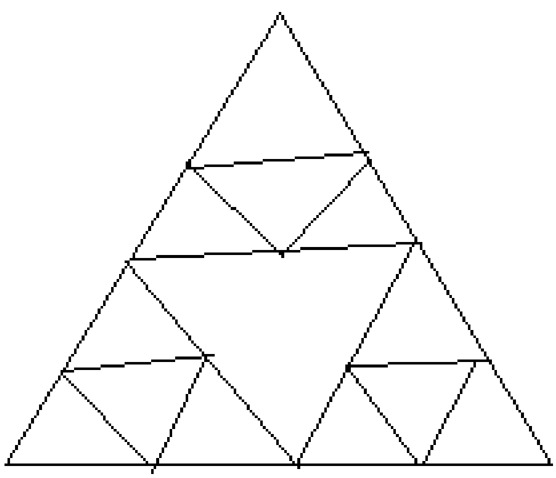


Figure 4: Parallel . Sierpinski gasket

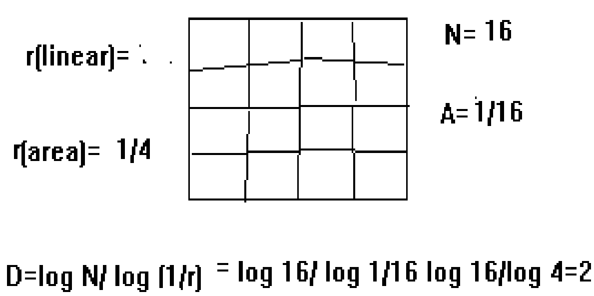


Figure 5: Parallel fractals

IV. Computer Generating Fractals

Computer generation fractals are any type of graphics with sale-similarities [3]. The recursion technical is used to generate fractals with self-similarities. The applications of fractal graphics ranging from graphics design to designing fractals on garments Python Programming is to generate Fractal Graphics [2]

```
# Fractal generation with phython
from turtle import *
def mink(lengthSide, levels):
        if levels == 0:
                forward(lengthSide)
                return
        lengthSide /= 3.0
        mink(lengthSide, levels-1)
        left(60)
        mink(lengthSide, levels-1)
        right(120)
        mink(lengthSide, levels-1)
        left(60)
        mink(lengthSide, levels-1)

if __name__ == "__main__":
        speed(0)
        length = 300.0
        penup()
        backward(length/2.0)
        pendown()
        for i in range(4):
                mink(length,4)
                right(120)
        mainloop()
```

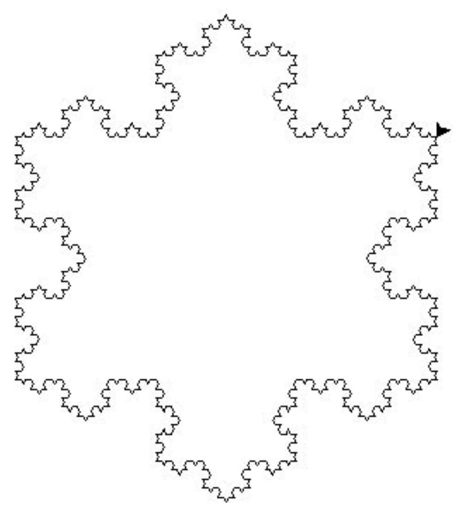


Figure 6: Koch curve

V. Conclusion

Fractals are structures which having the property of Scale-invariance or self-similarity. Self-similarity of a system implies that features of a structures are lookalike similar structures at different scales of length. Fractal Graphics have the number of applications in designing clothes and crafts. These a pplications are describes as fractals. Fractal dimension will identify the fractal structures or not. For instance, circles are not fractals. Different fractal structures are studied. The methods and techniques are also proposed for Computer generation of the fractals to simplify the process.

References Références Referencias

1. B.B. Mandeibrot, The fractal geometry of nature, W.H. Freeman, San Francisco, 1982.
2. Timoti Budd, Exploring Python, tata McGraw-Hill, New Delhi, 2010.
3. Poli Venkata Subba Reddy, "Computer Generations of Fractals", National Conference on Fractals and Its Applications, University of Hyderabad, Hyderabad, February21-23, 1991.

This page is intentionally left blank

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 21 Issue 1 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Feature Matching with Improved SIRB using RANSAC

By Meet Palod, Manas Joshi, Amber Jain, Viroang Rawat & Prof. K.K. Sharma

Abstract- In this paper, we suggest to improve the SIRB (SIFT (Scale-Invariant Feature Transform) and ORB (Oriented FAST and Rotated BRIEF)) algorithm by incorporating RANSAC to enhance the matching performance. We use multi-scale space to extract the features which are impervious to scale, rotation, and affine variations. Then the SIFT algorithm generates feature points and passes the interest points to the ORB algorithm. The ORB algorithm generates an ORB descriptor where Hamming distance matches the feature points. We propose to use RANSAC (Random Sample Consensus) to cut down on both the inliers in the form of noise and outliers drastically, to cut down on the computational time taken by the algorithm. This post-processing step removes redundant key points and noises. This computationally effective and accurate algorithm can also be used in handheld devices where their limited GPU acceleration is not able to compensate for the computationally expensive algorithms like SIFT and SURF. Experimental results advocate that the proposed algorithm achieves good matching, improves efficiency, and makes the feature point matching more accurate with scale in-variance taken into consideration.

GJCST-F Classification: G.4

Feature Matching with Improved SIRB using RANSAC

Meet Palod [α], Manas Joshi [σ], Amber Jain [ρ], Viroang Rawat [Ѡ] & Prof. K.K. Sharma [¥]

Abstract- In this paper, we suggest to improve the SIRB (SIFT (Scale-Invariant Feature Transform) and ORB (Oriented FAST and Rotated BRIEF)) algorithm by incorporating RANSAC to enhance the matching performance. We use multi-scale space to extract the features which are impervious to scale, rotation, and affine variations. Then the SIFT algorithm generates feature points and passes the interest points to the ORB algorithm. The ORB algorithm generates an ORB descriptor where Hamming distance matches the feature points. We propose to use RANSAC (Random Sample Consensus) to cut down on both the inliers in the form of noise and outliers drastically, to cut down on the computational time taken by the algorithm. This post-processing step removes redundant key points and noises. This computationally effective and accurate algorithm can also be used in handheld devices where their limited GPU acceleration is not able to compensate for the computationally expensive algorithms like SIFT and SURF. Experimental results advocate that the proposed algorithm achieves good matching, improves efficiency, and makes the feature point matching more accurate with scale in-variance taken into consideration.

I. Introduction

Feature extraction and the matching continue to be the cornerstone of computer vision technologies. Essentially in feature detection, we abstract the image information into numbers and make a local decision at every point to see if there exists an image feature at that point. These local decisions taken at multiple spots are what we call interest points or key points. Ideally, techniques used for key point detection and matching should be impervious to different changes like - rotation, scale variance, illumination changes, noise and perspective changes.

Another desirable characteristic of these algorithms is that the key points generated should be unique to a greater degree to match a single feature with high rates of success.

The process of feature detection and matching can be broken down into some essential steps:

1. Detecting Interest points - It is done based on the brightness of the image or on the boundary extraction method.
2. Description of interest points - We generate a description vector for each feature point that describes the local appearance around every feature point that is invariant under changes in illumination, translation, scale, and in-plane rotation.
3. Matching the interest points across images - We match similar features across the images and map them, establishing a connection between two similar images.

Now, these general steps can be implemented using distinct Algorithms. To this extent, numerous algorithms have been proposed. The SIFT algorithm has been historically the most popular algorithm due to its application in several fields using visual features like object recognition, image stitching, visual mapping etc. The overhead of computational burden that accompanies SIFT led to an intensive search for its replacement.

Real-time systems and low-power devices like cell phones cannot bear that computational burden. SIFT generally performs better than SURF in computational cost and is the most accurate feature-detector-descriptor for scale, rotation and affine variations.

SURF detects more features than the SIFT algorithm and the features are detected in a scattered form generally all over the image. SURF has the highest computational cost for feature matching. Using SURF on low-end devices was not possible, and so a faster and more efficient algorithm was required.

ORB detects the highest number of features that are more concentrated on corners. In all practical fields of comparison ORB performs better than SURF and SIFT or any other algorithm for that matter. It is computationally the fastest and most efficient.

SIRB is the latest addition to this arsenal of keypoint detection and matching algorithms. The SIRB algorithm conflates the accuracy of the SIFT algorithm and combines it with the computationally efficient algorithm of ORB, thus making it fast as well as accurate while also being unaffected by scale, rotation and affine variations. We have proposed to take this one step further and improve on the existing SIRB(SIFT+ORB) algorithm using RANSAC(Random sample consensus). The idea behind using RANSAC is to reduce the number of interest points and thus eliminating the non matching points. This can potentially reduce more than 50% of the points and because the number of points to be matched have been reduced we can considerably reduce the matching time.

Author α σ ρ Ѡ ¥: e-mails: meetpalod18@gmail.com, manasj514@gmail.com, amberjain.98@gmail.com, viroangrawat@gmail.com, kkssgs@gmail.com

Global Journal of Computer Science and Technology (F) Volume XXI Issue I Version I Year 2021

The RANSAC algorithm removes outliers or the data which does not fit the model. Its application in feature matching comes from the fact that it can handle more than 50% of the data as outliers, if applicable, and that has a drastic effect on time needed to generate a result. It is worth mentioning that RANSAC is a non-deterministic algorithm and that the results produced are reasonable only with a certain probability. This probability increases with the number of iterations. In RANSAC, we broadly perform these two steps iteratively:

1. Select a Minimal Sample Set(MSS) randomly from the input dataset and generate a model based on only these elements.
2. We now test which elements of the entire dataset are consistent with the model generated using the MSS. The set of elements which fit the model constitute a consensus set.

This process terminates when the probability of finding a better consensus set drops below a certain threshold.

The proposed method will reduce the number of points to be matched and offer a better alternative to the existing SIRB algorithm.

A feature or a keypoint is the distinctive piece of information, which is used for image matching, image stitching, and image registration. In an image, features are the specific structures like edges, corners, or objects. We detect corner points from an image which are also called interest points. An interest point in an image has a well defined position. These features extracted through the SIFT algorithm are invariant to rotation, scaling, and partially to illumination.

Keypoints are important because no matter how the image changes, we find the same key points in the modified image when comparing with the original image.

To detect keypoints, SIFT starts by generating the scale space for the image. Image at different scales is blurred by convolving a Gaussian kernel.

Scale-space is divided into octaves. In the original paper, Lowe [1] suggested that 4 octaves and 5 blur levels at each octave are ideal for the algorithm.

Each octave's image size is half of the previous octave and each image within an octave is increasingly blurred by a factor of k. The image is progressively blurred within an octave.

Mathematically, blurring is convolving the Gaussian operator and the image.

$$L(x,y,\sigma) = G(x,y,\sigma) * I(x,y) \qquad (1)$$

Here, G is the Gaussian kernel, I is an image, x, y are the location coordinates and defines the amount of blur. A bigger value of implies more blur. Now with the blurred images, we create another set of images, known as Difference of Gaussians (DoG). This DoG images are used for finding keypoints in the image. It is obtained as the difference of two progressively blurred images in an octave. This process is done for all octaves of the image in the scale space, and the desired scale space is obtained. It is represented in below image:

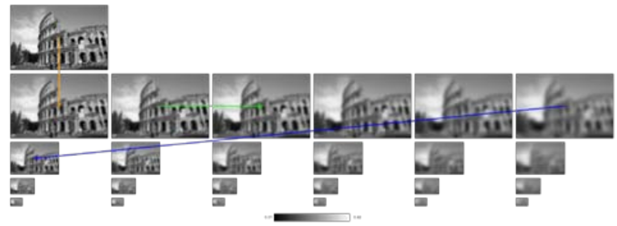


Fig. 1: Gaussian pyramid and Difference-of-Gaussian (DoG) pyramid

II. Local Maxima/Minima Detection

For computing local maxima or minima in the Difference of Gaussian, each point is compared to its eight neighbors in the image, 9 in the scale above and 9 in the scale below. Pixel is considered as a keypoint if its pixel intensity is more than all of the 26 neighboring points. Also, it is computationally efficient, because points are eliminated in the first few inspections.

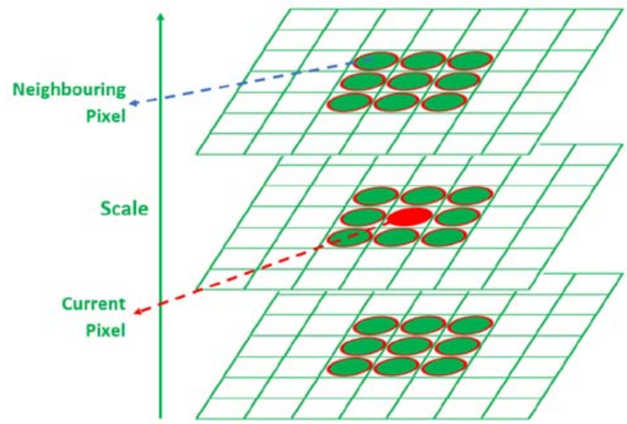


Fig. 2: Maxima and Minima are computed around the 3-dimensions x, y and σ.[15]

III. Key Point Localization Removing Keypoints with Low Contrast

After finding a possible keypoint by comparing it to neighboring pixels, the next task is to find datapoint location, scale, and ratio of principal curvatures. This process allows us to reject data points with low contrast which is sensitive to noise or localized along an edge. After it we fit a 3D quadratic function to the sample points to resolve the interpolated location of maximum and minimum. This approach uses Taylor expansion (2nd order) of the scale-space function, D (x, y, σ).

$$D(x) = D + \frac{\partial D^T}{\partial x}x + \frac{1}{2}x^T\frac{\partial^2 D}{\partial x^2}x \qquad (2)$$

Where D and the derivatives of D are calculated at the keypoint and x=(x, y, σ) T is the o set from this point. The correct location of keypoint extrema is x, and is evaluated by calculating the derivative of function D(x) concerning x and placing it to zero.

$$\hat{x} = -\frac{\partial^2 D^{-1}}{\partial x^2}\frac{\partial D}{\partial x} \quad (3)$$

The function value at extrema, (i.e. at $\hat{x}$) D ($\hat{x}$) is useful for removing keypoints with low contrast. The value D ($\hat{x}$) can be calculated by substituting value of bx in D($\hat{x}$).

$$D(\hat{x}) = D + \frac{1}{2}\frac{\partial D^T}{\partial x}x \quad (4)$$

Values less than 0.3 for the function value D($\hat{x}$) are rejected. A final trial for removing key points/feature points on edges are performed because these are unnecessary points and will create redundant key points in the matching process. A poorly defined extrema located at the ridge in the DoG, which depicts the edge in the image has broader principle curvature across the ridge and a low one along with it which is not present in a blob or (corner) having broad principle curvature along with both directions. Principle of curvature is evaluated by Hessian Matrix H.

$$H = \begin{bmatrix} D_{xx} & D_{xy} \\ D_{xy} & D_{yy} \end{bmatrix} \quad (5)$$

The eigenvalues corresponding to the Hessian matrix are tantamount to principle curvature. The ratio of eigenvalues λ1 and λ2 (which is proportional to principle curvature), are calculated with the help of Hessian matrix (H). This ratio is compared to certain threshold ratio r and high ratio points are repudiated. Where r = λ1/ λ2.

$$Tr(H) = D_{xx} + D_{yy} = \lambda_1 + \lambda_2 \quad (6)$$

$$Det(H) = D_{xx}D_{yy} - (D_{xx})^2 = \lambda_1\lambda_2 \quad (7)$$

$$\frac{Tr(H)^2}{Det(H)} = \frac{(\alpha+\beta)^2}{\alpha\beta} = \frac{(r\beta+\beta)^2}{r\beta^2} = \frac{(r+1)^2}{r} \quad (8)$$

Apply homogeneity to equations. The value of the term $(r+1)^2/r$ is minimum when both eigenvalues are equal, and it gradually increases with the value of r. Hence to check whether the ratio is below certain value, we used

$$\frac{Tr(H)^2}{Det(H)} = \frac{(\lambda_1+\lambda_2)^2}{\lambda_1\lambda_2} < \frac{(r+1)^2}{r} \quad (9)$$

We use the value of r =10 in this paper. Feature points above this threshold are repudiated.

IV. Orientation Assignment

Assigning orientation to keypoints ensures that it can be represented relative to its orientation and thus rotation invariance is achieved. To assign orientation, Histogram of Oriented Gradient (HOG) is used.

The scale of the keypoint is used to select the Gaussian smoothed image. Then, a 16x16 square window is considered around the detected keypoint.

For each pixel, L (x, y), at this scale, the gradient magnitude, m (x, y), and edge orientation, (x, y), is precomputed using pixel differences:

$$\theta(x,y) = tan^{-1}\left(\frac{L(x,y+1)-L(x,y-1)}{L(x+1,y)-L(x-1,y)}\right) \quad (10)$$

The edges below a threshold gradient magnitude are considered as weak edges and discarded. From the surviving edges, an orientation histogram is created. It has 36 bins covering the 360-degree range of orientations. Each pixel orientation added to the histogram is weighted by its gradient magnitude and by a Gaussian-weighted circular window with a that is 1.5 times that of the scale of the keypoint.

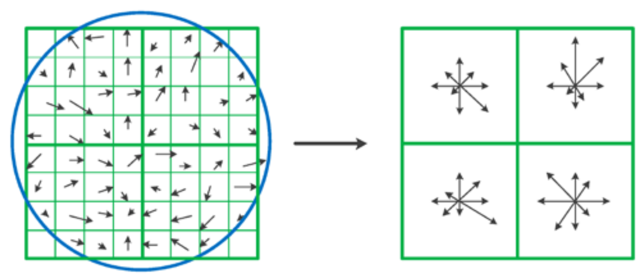


Fig. 3: Histogram of Gradient(HOG)[14]

Peaks in HOG correspond to the dominant orientation of the keypoint. If other peaks are detected within 80 percent of the dominant peak, then multiple keypoints are generated at the same location and scale with different orientation. These multiple orientation keypoint notably enhance the stability of matching.

V. rBRIEF: Rotation-Aware Briefs

After detecting all the key points, descriptors are generated for each keypoint. Feature descriptors encode unique information into a series of numbers and act like a numerical "fingerprint" that can be used to differentiate one feature from another. In this paper, we use the rBRIEF algorithm, a rotation-invariant version of the BRIEF algorithm. The BRIEF descriptor was proposed by M. Calonder [9]. BRIEF is an acronym for Binary robust independent elementary features, and it is robust to photometric and geometric image transformation.

The defined neighborhood, which is a square of some pixel width and height, around the keypoint is known as a patch. Brief depends on intensity difference tests to represent an image patch as a binary vector. Image patches could be effectively classified based on a relatively small number of pairwise intensity comparisons.

Each keypoint is described by a feature vector. Brief convert image patches into binary feature vectors, which are 128-512 bits string, so that together they can represent an object. The binary feature vector contains only 1's and 0's. Because BRIEF deals at the pixel level, it is very noise-sensitive. Hence it starts by smoothing the image with a Gaussian kernel. This reduces the sensitivity and also increases the stability and repeatability of the descriptors by pre-smoothing the patch.

To generate a 256-bit vector, it defines a randomly generated set of 256 pairs of pixels. The first pair in the random pair is taken from a Gaussian distribution drew around the keypoint with a standard deviation of 0.04 * S^2 (where S is the dimension of the patch). The second pair in the random pair is drawn from a Gaussian distribution drawn around the first pixel(x) with a standard deviation of 0.01 * S^2. rBRIEF achieves rotation invariance by moving these pixel locations by an angle equal to the orientation angle of the keypoint.

Then, it performs a binary test comparing the intensity of the first pixel in pair with the second pixel. If the intensity of the first pixel is less than the intensity of the second pixel, we append value 1 in the feature vector, else we append 0. When this binary test is performed on all the 256-pixel pairs in an image patch, we get a 256-bit binary vector, which is the desired descriptor.

VI. Ransac

RANSAC[8] algorithm is an extensively adapted mechanism in image processing for cleaning outliers from huge datasets. This algorithm helps in outlier removal, image noise filtration and optimal descriptors selection. RANSAC[6][7] does statistical estimations, which helps in evaluation for the likelihood of achieving accurate predictions.

RANSAC uses a minimal amount of data set to gain noise-repudiated data points, unlike other algorithms which initiate with huge datasets and then remove outliers.

Working of RANSAC:

- First, a minimum number of points are arbitrarily selected to define model parameters. From all the points, the points which fit according to the tolerance €(epsilon) are determined.
- Then we calculate the fraction of the number of inliers to total points present in the set.
- If the fraction is greater than a threshold (tau), which is predefined, we reevaluate parameters of the model using inliers.
- Else, we reiterate from step 1 to step 4, at most N times.

In this procedure, the value of N is taken large enough so that the minimum of one of the sets of random samples does not include any outlier. P represents probability which is set to 0.99, U represents chances of a selected data point as an inlier, V represents chances of selected data point as an outlier and N times the minimum number of points denoted M are required, so

$$1 - P = (1 - U^M)^N \tag{11}$$

After some formulations, N is chosen by the formula:

$$N = \frac{log(1-p)}{log(1-(1-V)^M)} \tag{12}$$

In our methodology, we aim to improve performance of SIRB by using RANSAC. RANSAC has been proven highly proficient in removing mismatched inconsistent sets of points. Since SIRB incorporates SIFT and ORB, therefore RANSAC has an intrinsic role in boosting the overall performance of SIRB. Due to the inaccuracy of SIFT, some points generated by it are mapped incorrectly, but RANSAC helps in filtering out these points, making SIFT more eficient. ORB [5] is an essential feature descriptor in low-end devices. So, it becomes crucial to eliminate shortcomings of ORB [12] and hence RANSAC is used as a post-quality improvement step to remove outliers and redundant key-points. RANSAC, thus makes SIRB more efficacious than some pre-existing methods, consequently making it an overall vigorous image recognition set-up.

VII. Match Feature Points Via Hamming Distance

The binary feature descriptor generated makes the matching process computationally more efficient because these binary vectors are stored in the form of bits. Performing operations like XOR on these binary vectors are much faster because of the ability to quickly compare descriptor pairs using few processor-level instructions. Algorithms like SIFT/SURF use Euclidean distance to compare binary feature vectors. We found that using hamming distance[11] for matching the key points is more efficient when comparing binary feature vectors. Therefore, we have used Hamming distance for our research.

The hamming distance is the value of the number of positions where both binary vectors differ. It is denoted by d(a, b), where a and b are two binary vectors. It can also be calculated by performing XOR operation on given two binary vectors.

$$d_{hamming}(a,b) = \sum_{i=0}^{n-1}(a_i \oplus b_i) \tag{13}$$

VIII. Conclusion

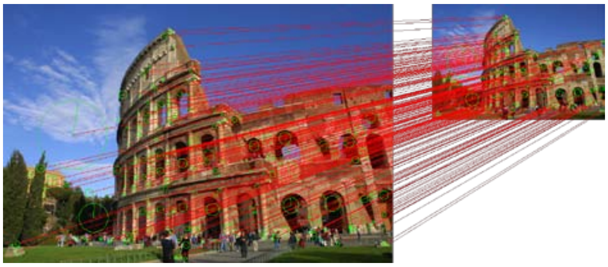


Fig. 4: Matching Result for Images with Scale Changes

We proposed a new algorithm, SIRB+RANSAC. It inherits the innate accuracy of the SIFT algorithm and the fast superiority of ORB. Its performance is further enhanced by using the RANSAC algorithm, which eliminates mismatches to a great extent. We start by describing the SIFT keypoint detection algorithm. We then introduced the rBrief method for binary descriptor generation. We used Hamming Distance to match the binary descriptors generated. Finally, we used the RANSAC algorithm to remove the mismatched keypoint pairs and eliminate the outliers.

The results of the experiment show that the new enhanced SIRB+RANSAC algorithm effectively resolves the problem that the ORB algorithm performs poorly in terms of scale invariance, and it is sensitive to image illumination. Based on the results of the experiment, we conclude that:

- The average matching accuracy of our algorithm is 89.85% as compared to the 86.95% accuracy of the traditional SIRB algorithm. The SIFT algorithm still presents an accuracy of 94.20%.
- The average computational time of the new improved SIRB+RANSAC algorithm is 87.69ms, which is about 42 times faster than the SIFT algorithm which takes an average of 3723ms. On the other hand, the SIRB algorithm takes 74.33ms.

The proposed algorithm will be exceptionally useful on low-end hand-held devices with low GPU power because it involves relatively less computational expenses than the prevalent algorithms. It also has applications in traditional systems where SIFT or SURF is currently being used.

IX. Future Work

It is evident from experimental results that the average matching time for SIRB is significantly less when compared with the SIFT algorithm. However, the matching accuracy has also dropped by 4.61%. We have released the source code of our algorithm so that it can be used by other researchers. There is the scope for improvement in our proposed algorithm, and these are the fields where future research can be directed:

- Instead of using Gaussian filters for convolution, filters like average filter and median filters can be used to reduce the run time of the algorithm while maintaining accuracy.
- Use improved RANSAC, modified RANSAC or optimal RANSAC to remove parts of the error feature point, thus increasing the proportion of correct matching features.
- Remove the repeatable and unstable key points generated after normalizing the scale space.

References Références Referencias

1. D. G. Lowe, Object recognition from local scale-invariant features, In Proceedings of the Seventh IEEE International Conference on Computer Vision, 1999, ICCV.1999.790410.
2. K. Yang and D. Yin and J. Zhang and H. Xiao and K. Luo, An Improved ORB Algorithm of Extracting Features Based on Local Region Adaptive Threshold, In 2019 6th International Conference on Systems and Informatics (ICSAI), 2019, ICSAI48974. 2019.9010209.
3. E. Rublee and V. Rabaud and K. Konolige and G. Bradski, ORB: An efficient alternative to SIFT or SURF, In 2011 International Conference on Computer Vision, 2011, ICCV.2011.6126544.
4. M. Zhao and H. Chen and T. Song and S. Deng, Research on image matching based on improved RANSAC-SIFT algorithm, In 2017 16th International Conference on Optical Communications and Networks (ICOCN), 2017, ICOCN.2017.8121270.
5. Y. Qin and H. Xu and H. Chen, Image feature points matching via improved ORB, In 2014 IEEE International Conference on Progress in Informatics and Computing, 2014, PIC.2014.6972325.
6. G. Shi and X. Xu and Y. Dai SIFT Feature Point Matching Based on Improved RANSAC Algorithm, In 2013 5th International Conference on Intelligent Human-Machine Systems and Cybernetics, 2013, IHMSC.2013.119.
7. O. Chum and J. Matas, Optimal Randomized RANSAC, In IEEE Transactions on Pattern Analysis and Machine Intelligence. 2008, TPAMI.2007.70787
8. S. Yang and B. Li, Outliers Elimination Based Ransac for Fundamental Matrix Estimation, In 2013 International Conference on Virtual Reality and Visualization, 2013, ICVRV.2013.63.
9. M. Calonder and V. Lepetit and M. Ozuysal and T. Trzcinski and C. Strecha and P. Fua, BRIEF: Computing a Local Binary Descriptor Very Fast, In IEEE Transactions on Pattern Analysis and Machine Intelligence, 2012, TPAMI.2011.222.
10. Xue Leng and Jinhua Yang, Improvement of ORB algorithm, In Proceedings of the 2015 International Conference on Materials Engineering And Information Technology Applications, 2015 https://doi.org/10.2991/meita-15.2015.169.

11. M. Su and Y. Ma and X. Zhang and S. Li and Y. Zhang A Binary SIFT Matching Method Combined with the Color and Exposure Information, In 2017 International Conference on Network and Information Systems for Computers (ICNISC), 2017, IC-NISC.2017.00062.
12. F. Tian and P. Shi, Image Mosaic using ORB descriptor and improved blending algorithm, In 2014 7th International Congress on Image and Signal Processing, 2014, CISP.2014.7003867.
13. Wei He and Takayoshi Yamashita and Hongtao Lu and Shihong Lao, SURF Tracking, In 2009 IEEE 12th International Conference on Computer Vision, 2009, ICCV.2009.5459360.
14. Zhang Y, Wang C, Zhou X. RST Resilient Watermarking Scheme Based on DWT-SVD and Scale-Invariant Feature Transform. Algorithms. 2017; 10(2):41. https://doi.org/10.3390/a10020041.
15. Lowe, D.G. Distinctive Image Features from Scale-Invariant Keypoints. International Journal of Computer Vision 60, 91–110 (2004). https://doi.org/10.1023/B:VISI.0000029664.99615.94.

Global Journals Guidelines Handbook 2021

www.GlobalJournals.org

Memberships

Fellows/Associates of Computer Science Research Council

FCSRC/ACSRC Memberships

Introduction

FCSRC/ACSRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FCSRC/ACSRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FCSRC

Fellow of Computer Science Research Council

FELLOW OF COMPUTER SCIENCE RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

Benefit

To the institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A FCSRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly.They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Certificate, LoR and Laser-Momento

Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Fellows can use the honored title of membership. The “FCSRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FCSRC or William Walldroff, M.S., FCSRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Fellow members of FCSRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career Financial

GJ Account

Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career Credibility Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career Credibility Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 60% of sales proceeds

Fellows can publish articles (limited) without any fees. Also, they can earn up to 70% of sales proceeds from the sale of reference/review books/literature/publishing of research paper. The FCSRC member can decide its price and we can help in making the right decision.

Exclusive Financial

Reviewers

Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

Access to Editorial Board

Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career Credibility Exclusive Reputation

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ACSRC

ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL

ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

> The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

Benefit

To the Institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A ACSRC member gets access to a closed network of Tier 2 researchers and scientists with direct communication channel through our website. Associates can reach out to other members or researchers directly.They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Certificate, LoR and Laser-Momento

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Associates can use the honored title of membership. The “ACSRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., ACSRC or William Walldroff, M.S., ACSRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Associate members of ACSRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Associates receive discounts on future publications with Global Journals up to 30%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career Financial

GJ Account

Unlimited forward of Emails

Associates get secure and fast GJ work emails with 5GB forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career Credibility Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, associates receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career Credibility Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All associates receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive | Financial

Reviewers

Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento 2 discounted publishing/year **Gradation** of Research 10 research contacts/day 1 **GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day 5 **GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Computer Science Research Paper

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10.Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- o Single section and succinct.
- o An outline of the job done is always written in past tense.
- o Concentrate on shortening results—limit background information to a verdict or two.
- o Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

Index

save our planet

Global Journal of Computer Science and Technology

Visit us on the Web at www.GlobalJournals.org | www.ComputerResearch.org
or email us at helpdesk@globaljournals.org

ISSN 9754350