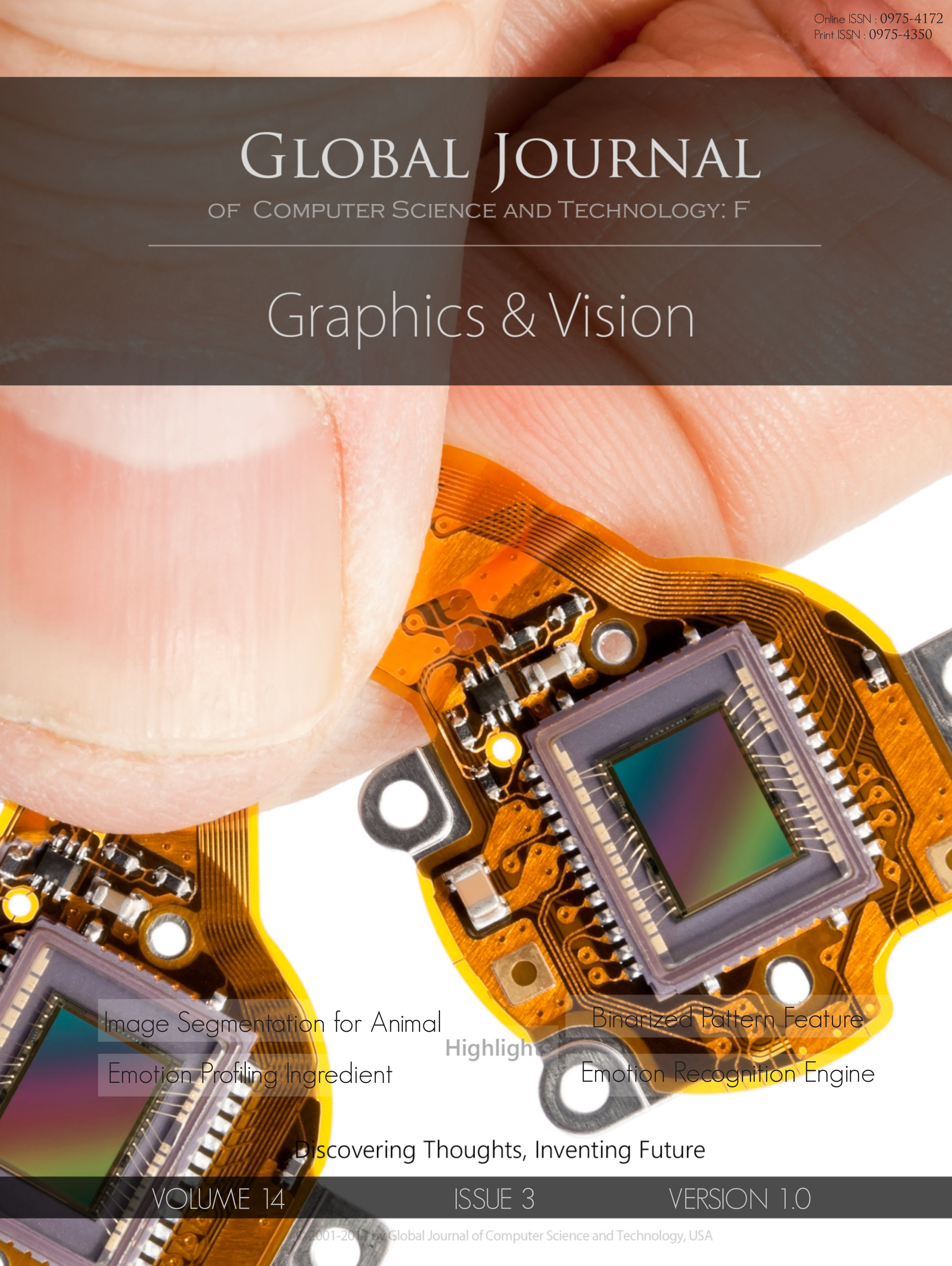
Online ISSN : 0975-4172
Print ISSN : 0975-4350



Global Journal

of Computer Science and Technology: F

Graphics & Vision

Image Segmentation for Animal

Binarized Pattern Feature

Highlights

Emotion Profiling Ingredient

Emotion Recognition Engine

Discovering Thoughts, Inventing Future

VOLUME 14 ISSUE 3 VERSION 1.0

© 2001-2014 by Global Journal of Computer Science and Technology, USA

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

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

Volume 14 Issue 3 (Ver. 1.0)

Open Association of Research Society

© Global Journal of Computer Science and Technology. 2014.

All rights reserved.

This is a special issue published in version 1.0 of "Global Journal of Computer Science and Technology "By Global Journals Inc.

All articles are open access articles distributedunder "Global Journal of Computer Science and Technology"

Reading License, which permits restricted use. Entire contents are copyright by of "Global Journal of Computer Science and Technology" unless otherwise noted on specific articles.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without written permission.

The opinions and statements made in this book are those of the authors concerned. Ultraculture has not verified and neither confirms nor denies any of the foregoing and no warranty or fitness is implied.

Engage with the contents herein at your own risk.

The use of this journal, and the terms and conditions for our providing information, is governed by our Disclaimer, Terms and Conditions and Privacy Policy given on our website http://globaljournals.us/terms-and-condition/menu-id-1463/

By referring / using / reading / any type of association / referencing this journal, this signifies and you acknowledge that you have read them and that you accept and will be bound by the terms thereof.

All information, journals, this journal, activities undertaken, materials, services and our website, terms and conditions, privacy policy, and this journal is subject to change anytime without any prior notice.

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
301st Edgewater Place Suite, 100 Edgewater Dr.-Pl,
Wakefield MASSACHUSETTS, Pin: 01880,
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
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 (Including by Air Parcel Charges):

For Authors:
22 USD (B/W) & 50 USD (Color)
Yearly Subscription (Personal & Institutional):
200 USD (B/W) & 250 USD (Color)

Integrated Editorial Board
(Computer Science, Engineering, Medical, Management, Natural Science, Social Science)

John A. Hamilton,"Drew" Jr.,
Ph.D., Professor, Management
Computer Science and Software Engineering
Director, Information Assurance Laboratory
Auburn University

Dr. Henry Hexmoor
IEEE senior member since 2004
Ph.D. Computer Science, University at Buffalo
Department of Computer Science
Southern Illinois University at Carbondale

Dr. Osman Balci, Professor
Department of Computer Science
Virginia Tech, Virginia University
Ph.D.and M.S.Syracuse University, Syracuse, New York
M.S. and B.S. Bogazici University, Istanbul, Turkey

Yogita Bajpai
M.Sc. (Computer Science), FICCT
U.S.A.Email: yogita@computerresearch.org

Dr. T. David A. Forbes
Associate Professor and Range Nutritionist
Ph.D. Edinburgh University - Animal Nutrition
M.S. Aberdeen University - Animal Nutrition
B.A. University of Dublin- Zoology

Dr. Wenying Feng
Professor, Department of Computing & Information Systems
Department of Mathematics
Trent University, Peterborough,
ON Canada K9J 7B8

Dr. Thomas Wischgoll
Computer Science and Engineering,
Wright State University, Dayton, Ohio
B.S., M.S., Ph.D.
(University of Kaiserslautern)

Dr. Abdurrahman Arslanyilmaz
Computer Science & Information Systems Department
Youngstown State University
Ph.D., Texas A&M University
University of Missouri, Columbia
Gazi University, Turkey

Dr. Xiaohong He
Professor of International Business
University of Quinnipiac
BS, Jilin Institute of Technology; MA, MS, PhD,. (University of Texas-Dallas)

Burcin Becerik-Gerber
University of Southern California
Ph.D. in Civil Engineering
DDes from Harvard University
M.S. from University of California, Berkeley & Istanbul University

Dr. Bart Lambrecht
Director of Research in Accounting and FinanceProfessor of Finance
Lancaster University Management School
BA (Antwerp); MPhil, MA, PhD (Cambridge)

Dr. Carlos García Pont
Associate Professor of Marketing
IESE Business School, University of Navarra
Doctor of Philosophy (Management), Massachusetts Institute of Technology (MIT)
Master in Business Administration, IESE, University of Navarra
Degree in Industrial Engineering, Universitat Politècnica de Catalunya

Dr. Fotini Labropulu
Mathematics - Luther College
University of ReginaPh.D., M.Sc. in Mathematics
B.A. (Honors) in Mathematics
University of Windso

Dr. Lynn Lim
Reader in Business and Marketing
Roehampton University, London
BCom, PGDip, MBA (Distinction), PhD, FHEA

Dr. Mihaly Mezei
ASSOCIATE PROFESSOR
Department of Structural and Chemical Biology, Mount Sinai School of Medical Center
Ph.D., Etvs Lornd University
Postdoctoral Training,
New York University

Dr. Söhnke M. Bartram
Department of Accounting and FinanceLancaster University Management SchoolPh.D. (WHU Koblenz)
MBA/BBA (University of Saarbrücken)

Dr. Miguel Angel Ariño
Professor of Decision Sciences
IESE Business School
Barcelona, Spain (Universidad de Navarra)
CEIBS (China Europe International Business School).
Beijing, Shanghai and Shenzhen
Ph.D. in Mathematics
University of Barcelona
BA in Mathematics (Licenciatura)
University of Barcelona

Philip G. Moscoso
Technology and Operations Management
IESE Business School, University of Navarra
Ph.D in Industrial Engineering and Management, ETH Zurich
M.Sc. in Chemical Engineering, ETH Zurich

Dr. Sanjay Dixit, M.D.
Director, EP Laboratories, Philadelphia VA Medical Center
Cardiovascular Medicine - Cardiac Arrhythmia
Univ of Penn School of Medicine

Dr. Han-Xiang Deng
MD., Ph.D
Associate Professor and Research Department Division of Neuromuscular Medicine
Davee Department of Neurology and Clinical NeuroscienceNorthwestern University
Feinberg School of Medicine

Dr. Pina C. Sanelli
Associate Professor of Public Health
Weill Cornell Medical College
Associate Attending Radiologist
NewYork-Presbyterian Hospital
MRI, MRA, CT, and CTA
Neuroradiology and Diagnostic Radiology
M.D., State University of New York at Buffalo,School of Medicine and Biomedical Sciences

Dr. Roberto Sanchez
Associate Professor
Department of Structural and Chemical Biology
Mount Sinai School of Medicine
Ph.D., The Rockefeller University

Dr. Wen-Yih Sun
Professor of Earth and Atmospheric SciencesPurdue University Director
National Center for Typhoon and Flooding Research, Taiwan
University Chair Professor
Department of Atmospheric Sciences, National Central University, Chung-Li, TaiwanUniversity Chair Professor
Institute of Environmental Engineering, National Chiao Tung University, Hsin-chu, Taiwan.Ph.D., MS The University of Chicago, Geophysical Sciences
BS National Taiwan University, Atmospheric Sciences
Associate Professor of Radiology

Dr. Michael R. Rudnick
M.D., FACP
Associate Professor of Medicine
Chief, Renal Electrolyte and Hypertension Division (PMC)
Penn Medicine, University of Pennsylvania
Presbyterian Medical Center, Philadelphia
Nephrology and Internal Medicine
Certified by the American Board of Internal Medicine

Dr. Bassey Benjamin Esu
B.Sc. Marketing; MBA Marketing; Ph.D Marketing
Lecturer, Department of Marketing, University of Calabar
Tourism Consultant, Cross River State Tourism Development Department
Co-ordinator , Sustainable Tourism Initiative, Calabar, Nigeria

Dr. Aziz M. Barbar, Ph.D.
IEEE Senior Member
Chairperson, Department of Computer Science
AUST - American University of Science & Technology
Alfred Naccash Avenue – Ashrafieh

President Editor (HON.)

Dr. George Perry, (Neuroscientist)
Dean and Professor, College of Sciences
Denham Harman Research Award (American Aging Association)
ISI Highly Cited Researcher, Iberoamerican Molecular Biology Organization
AAAS Fellow, Correspondent Member of Spanish Royal Academy of Sciences
University of Texas at San Antonio
Postdoctoral Fellow (Department of Cell Biology)
Baylor College of Medicine
Houston, Texas, United States

Chief Author (HON.)

Dr. R.K. Dixit
M.Sc., Ph.D., FICCT
Chief Author, India
Email: authorind@computerresearch.org

Dean & Editor-in-Chief (HON.)

Vivek Dubey(HON.)
MS (Industrial Engineering),
MS (Mechanical Engineering)
University of Wisconsin, FICCT
Editor-in-Chief, USA
editorusa@computerresearch.org

Sangita Dixit
M.Sc., FICCT
Dean & Chancellor (Asia Pacific)
deanind@computerresearch.org

Suyash Dixit
(B.E., Computer Science Engineering), FICCTT
President, Web Administration and
Development , CEO at IOSRD
COO at GAOR & OSS

Er. Suyog Dixit
(M. Tech), BE (HONS. in CSE), FICCT
SAP Certified Consultant
CEO at IOSRD, GAOR & OSS
Technical Dean, Global Journals Inc. (US)
Website: www.suyogdixit.com
Email:suyog@suyogdixit.com

Pritesh Rajvaidya
(MS) Computer Science Department
California State University
BE (Computer Science), FICCT
Technical Dean, USA
Email: pritesh@computerresearch.org

Luis Galárraga
J!Research Project Leader
Saarbrücken, Germany

Contents of the Volume

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 14 Issue 3 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Image Segmentation for Animal Images using Finite Mixture of Pearson type VI Distribution

By K. Srinivasa Rao, P. Chandra Sekhar & P. Srinivasa Rao

GITAM University, India

Abstract- Image Segmentation is one of the significant tool for analyzing images, the feature vector of the images are different for different types of images. In remote sensing, Environmental ecological systems, forest studies, conservation of rare animals, the animal images are more important. In this paper we developed and analyze an image segmentation algorithm using mixture of Pearson Type VI Distribution. The Pearsonian Type VI Distribution will characterize the image regions of animal images. The appropriateness Pearsonian Type VI distribution for the pixel intensities of image region in animal images is carried by fitting Pearsonian Type VI Distribution to set of animal images taken from Berkeley image data set. The image segmentation algorithm is developed using EM algorithm for estimating the parameters of the model and maximum likelihood for image component under Bayesian framework. For fast convergence of EM algorithm the initial estimates of the model parameters are obtained by dividing the whole image into K image regions using K-means and Hierarchical clustering algorithm and utilizing the moment method of estimates. The performance of proposed algorithm is studied by conducting an experiment with set of animal images and computing image quality metrics such as PRI, GCE and VOI.

Keywords: EM algorithm, image segmentation, performance measures, type VI pearsonian.

GJCST-F Classification : I.4.0

IMAGESEGMENTATIONFORANIMALIMAGESUSINGFINITEMXTUREOFPEARSONTYPEVIDISTRIBUTION

Strictly as per the compliance and regulations of:

© 2014. K. Srinivasa Rao, P. Chandra Sekhar & P. Srinivasa Rao. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction inany medium, provided the original work is properly cited.

Image Segmentation for Animal Images using Finite Mixture of Pearson type VI Distribution

K. Srinivasa Rao [α], P. Chandra Sekhar [σ] & P. Srinivasa Rao [ρ]

Abstract- Image Segmentation is one of the significant tool for analyzing images, the feature vector of the images are different for different types of images. In remote sensing, Environmental ecological systems, forest studies, conservation of rare animals, the animal images are more important. In this paper we developed and analyze an image segmentation algorithm using mixture of Pearson Type VI Distribution. The Pearsonian Type VI Distribution will characterize the image regions of animal images. The appropriateness Pearsonian Type VI distribution for the pixel intensities of image region in animal images is carried by fitting Pearsonian Type VI Distribution to set of animal images taken from Berkeley image data set. The image segmentation algorithm is developed using EM algorithm for estimating the parameters of the model and maximum likelihood for image component under Bayesian framework. For fast convergence of EM algorithm the initial estimates of the model parameters are obtained by dividing the whole image into K image regions using K-means and Hierarchical clustering algorithm and utilizing the moment method of estimates. The performance of proposed algorithm is studied by conducting an experiment with set of animal images and computing image quality metrics such as PRI, GCE and VOI. A comparative study of developed image segmentation by Gaussian Mixture model and found the proposed algorithm performed better for animal images due to asymmetrically distributed nature of pixel intensities in the image regions.

Keywords: EM algorithm, image segmentation, performance measures, type VI pearsonian.

I. Introduction

In image processing and retrievals image analysis plays a dominant role. The major task in image analysis is extracting useful information using features of the image. Generally image analysis techniques broadly grouping into groups namely (1) Structural methods (2) Statistical methods Raj Kumar et al (2011), among these two groups statistical methods are much popular. In Statistical methods one of the prime considerations is dividing whole image into different image regions using probability distributions. This type of method is usually referred as image Segmentation.

Much work has been reported in literature regarding image segmentation methods. Pal S.K and Pal N. R. (1993), Cheng et al (2001), Srinivasa et al (2007), Srinivas Y et al (2010), Prasad Reddy et al (2007) have reviewed the image segmentation methods. There is no unique image segmentation method available for analyzing all images. The image segmentation is basically dependent on type of images. The image broadly categorized into four types of categories . They are (1) Images on Earth (2) images of Humans and animals (3) images on sky (4) images on Water and (5) images of Nature. Among these categories the images of Human beings and Animals are in different in nature and features are associated with these images are different from others in some statistical sense. These images are Skewed in nature. Hence the image segmentation methods based on Gaussian mixture model given by Cheng et al (2001), Yamazaki T. et al (1998), Zhang Z.H et al (2003), Lie T. et al (1993) may not suit well. Even the methods given by Sesha sayee et al (2011), Srinivasa et al (2011) are also may not suit since these methods also focus on symmetry of the pixel intensities in the image region. Hence to have suitable and more appropriate image segmentation methods for animals, an image segmentation method using a mixture of Pearsonian Type VI Distribution is developed and analyzed. Here it is assumed that whole image is characterized by a mixture of Pearsonian Type VI probability model. The Pearsonian Type VI Distribution is skewed in nature having long upper tails. This distribution also includes several distributions as particular case. From the Berkeley image data set collected over animal images. It is evident that the pixel intensities of these images are well categorized by mixture of Pearsonian Type VI Distribution. The model parameters are estimated by updated equations of EM algorithm. The initial values of the model parameters of EM Algorithm are carried using Histograms of the whole image and K-means and Hierarchical clustering Algorithm and moment method of estimates. The image segmentation algorithm is developed through Maximum Likelihood component under Bayesian frame. The performance of image segmentation algorithm is skewed using image quality metrics and ground truth values. The comparative study of proposed algorithm with that of Gaussian Mixture Model is also carried.

Author α: Department of Statistics, Andhra University, Visakhapatnam. e-mail: ksraoau@yahoo.co.in
Author σ: Department of IT, GITAM University, Visakhapatnam. e-mail: chandoo.potala@gmail.com
Author ρ: Department of CS&SE, Andhra University, Visakhapatnam. e-mail: peri.srinivasarao@yahoo.com

© 2014 Global Journals Inc. (US)

II. Mixture of Pearson Type VI Distribution

Usually the entire image is considered as a union of several image regions in low level image analysis and the image data is quantified by pixel intensities in each image region. Because of the fact that the brightness measured at a point in the image is influenced by various random factors like environmental conditions, vision, moisture, lighting etc, the pixel intensity $z = f(x, y)$ for a given point (pixel) (x, y) is a random variable. It is generally assumed that the pixel intensities of the region follow a Pearson Type VI distribution in order to model the pixel intensities of the animal and human image regions. The probability density function of the pixel intensity is

$$f_i(z / a_{i1}, q_{i1}, q_{i2}) = \frac{(z_s - a_i)^{q_{i2}} (z_s)^{-q_{i1}}}{(a_i)^{(q_{i2}-q_{i1}+1)} B(q_{i1} - q_{i2} - 1, q_{i2} + 1)} \quad ,(1)$$

$$a_i \le z_i < \alpha$$

The entire animal and human image is a collection of regions which are characterized by Pearson Type VI distribution. Here, it is assumed that the pixel intensities of the whole image follows a K – component mixture of Pearson Type VI distribution and its probability density function is of the form

$$p(z) = \sum_{i=1}^{K} \alpha_i \; f_i(z / a_{i1}, q_{i1}, q_{i2}) \qquad (2)$$

where, K is number of regions , $0 \le \alpha_i \le 1$ are weights such that $\sum \alpha_i = 1$ and $f_i(z / a_{i1}, q_{i1}, q_{i2})$ is as given in equation (1). In the whole image α_i is the weight associated with i[th] region. Usually the intensities of the pixel in the image regions are statistically correlated and can be reduced by spatial averaging (Kelly P.A. et al (1998)) or spatial sampling (Lei T. and Sewehand W. (1992)) .The pixels are considered to be uncorrelated and independent after reduction of correlation. The mean pixel intensity of the whole image is $E(Z) = \sum_{i=1}^{K} \alpha_i \mu_i$

III. Estimation of the Model Parameters by EM Algorithm

In this section we derive the updated equations of the model parameters using Expectation Maximization (EM) algorithm. The likelihood function of the observations $z_1, z_2, \ldots, z_N$ drawn from an image is

$$L(\theta) = \prod_{S=1}^{N} p(z_s, \theta^{(l)}) \text{ That is } L(\theta) = \prod_{s=1}^{N} \left(\sum_{i=1}^{K} \alpha_i f_i(z_s, \theta) \right)$$

$$\text{This implies } \log L(\theta) = \sum_{s=1}^{N} \log \left(\sum_{i=1}^{K} \alpha_i f_i(z_s, \theta) \right)$$

Where $\theta = (a_{i1}, q_{i1}, q_{i2}, \alpha_i; i = 1, 2, \ldots, K)$ is the set of parameters.

$$\log L(\theta) = \sum_{s=1}^{N} \log \left[\sum_{i=1}^{K} \frac{\alpha_i (z_s - a_i)^{q_{i2}} (z_s)^{-q_{i1}}}{(a_i)^{(q_{i2}-q_{i1}+1)} B(q_{i1} - q_{i2} - 1, q_{i2} + 1)} \right] \quad , (3)$$

The first step of the EM algorithm requires the estimation of the likelihood function of the sample observations.

a) E-Step

In the expectation (E) step, the expectation value of log $L(\theta)$ with respect to the initial parameter vector $\theta^{(0)}$ is

$$Q\left(\theta; \theta^{(0)}\right) = E_{\theta^{(0)}} \left[\log L(\theta) / \bar{z}\right]$$

Given the initial parameters $\theta^{(0)}$, one can compute the density of pixel intensity z_s as

$$p(z_s, \theta^{(l)}) = \sum_{i=1}^{K} \alpha_i^{(l)} f_i(z_s, \theta^{(l)})$$

$$L(\theta) = \prod_{s=1}^{N} p(z_s, \theta^{(l)})$$

$$\text{This implies } \log L(\theta) = \sum_{s=1}^{N} \log \left(\sum_{i=1}^{K} \alpha_i f_i(z_s, \theta^{(l)}) \right) \qquad (4)$$

The conditional probability of any observation z_s, belongs to any region K is

$$t_k(z_s, \theta^{(l)}) = \left[\frac{\alpha_k^{(l)} f_k(z_s, \theta^{(l)})}{p(z_s, \theta^{(l)})} \right] = \left[\frac{\alpha_k^{(l)} f_k(z_s, \theta^{(l)})}{\sum_{i=1}^{K} \alpha_i^{(l)} f_i(z_s, \theta^{(l)})} \right]$$

The expectation of the log likelihood function of the sample is

$$Q\left(\theta; \theta^{(l)}\right) = E_{\theta^{(l)}} \left[\log L(\theta) / \bar{z}\right]$$

Following the heuristic arguments of Jeff A. Bilmes (1997) we have

$$Q\left(\theta; \theta^{(l)}\right) = \sum_{i=1}^{K} \sum_{s=1}^{N} \left(t_i(z_s, \theta^{(l)}) \left(\log f_i(z_s, \theta^{(l)}) + \log \alpha_i^{(l)} \right) \right) \qquad (5)$$

But we have

$$f_i(z / a_{i1}, q_{i1}, q_{i2}) = \frac{(z_s - a_i)^{q_{i2}} (z_s)^{-q_{i1}}}{(a_i)^{(q_{i2}-q_{i1}+1)} B(q_{i1} - q_{i2} - 1, q_{i2} + 1)}$$

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014
2

© 2014 Global Journals Inc. (US)

$$Q\left(\theta;\theta^{(l)}\right)=\sum_{i=1}^{K}\sum_{s=1}^{N}\left(t_i(z_s,\theta^{(l)})\left(\log f_i(z_s,\theta^{(l)})+\log\alpha_i^{(l)}\right)\right)$$

b) M-Step

For obtaining the estimation of the model parameters one has to maximize $Q\left(\theta;\theta^{(l)}\right)$ such that $\sum\alpha_i = 1$. This can be solved by applying the standard solution method for constrained maximum by constructing the first order Lagrange type function,

$$S=\left[E(\log L(\theta^{(l)}))+\lambda\left(1-\sum_{i=1}^{K}\alpha_i^{(l)}\right)\right] \qquad (6)$$

where, λ is Lagrangian multiplier combining the constraint with the log likelihood function to be maximized.

Hence, $\frac{\partial S}{\partial\alpha_i}=0$. This implies

$$\frac{\partial}{\partial\alpha_i}\left[\sum_{i=1}^{K}\sum_{s=1}^{N}t_i(z_s,\theta^{(l)})\left[\log\left[\frac{(z_s-a_i)^{q_{i2}}(z_s)^{-q_{i1}}}{(a_i)^{(q_{i2}-q_{i1}+1)}B(q_{i1}-q_{i2}-1,q_{i2}+1)}\right]+\log\alpha_i\right]\right]$$
$$+\lambda\left(1-\sum_{i=1}^{K}\alpha_i\right)=0$$

This implies $\sum_{i=1}^{N}\frac{1}{\alpha_i}t_i(z_s,\theta^{(l)})+\lambda=0$

Summing both sides over all observations, we get λ = -N Therefore $\hat{\alpha}_i=\frac{1}{N}\sum_{s=1}^{N}t_i(z_s,\theta^{(l)})$ The updated equation of α_i for $(l+1)^{th}$ iteration is

$$\alpha_i^{(l+1)}=\frac{1}{N}\sum_{s=1}^{N}t_i(z_s,\theta^{(l)})$$

$$\alpha_i^{(l+1)}=\frac{1}{N}\sum_{s=1}^{N}\left[\frac{\alpha_i^{(l)}f_i(z_s,\theta^{(l)})}{\sum_{i=1}^{K}\alpha_i^{(l)}f_i(z_s,\theta^{(l)})}\right] \qquad (7)$$

Therefore $\frac{\partial}{\partial a_i}Q\left(\theta;\theta^{(l)}\right)=0$ implies $E\left[\frac{\partial\log L(\theta;\theta^{(l)})}{\partial a_{i1}}\right]=0$

$$\frac{\partial}{\partial a_i}\left[\sum_{i=1}^{K}\sum_{s=1}^{N}\left(t_i(z_s,\theta^{(l)})\left(\log f_i(z_s,\theta^{(l)})+\log\alpha_i^{(l)}\right)\right)\right]=0$$

The updated equation of a_i at $(l+1)$th iteration is

$$a_i^{(l+1)}=\sum_{s=1}^{N}\left[\frac{-(q_{i2}^{(l)}-q_{i1}^{(l)}+1)\left(z_s-a_i^{(l)}\right)t_i(z_s,\theta^{(l)})}{t_i(z_s,\theta^{(l)})q_{i2}^{(l)}}\right]$$

For updating the parameter q_{i1} , i = 1, 2, …, K we consider the derivative of $Q\left(\theta;\theta^{(l)}\right)$ with respect to q_{i1} and equate it to zero. We have

$$Q\left(\theta;\theta^{(l)}\right)=E\left[\log L(\theta;\theta^{(l)})\right]$$

Therefore $\frac{\partial}{\partial q_{i1}}Q\left(\theta;\theta^{(l)}\right)=0$ implies $E\left[\frac{\partial\log L(\theta;\theta^{(l)})}{\partial q_{i1}}\right]=0$

$$\frac{\partial}{\partial q_{i1}}\left[\sum_{i=1}^{K}\sum_{s=1}^{N}\left(t_i(z_s,\theta^{(l)})\left(\log f_i(z_s,\theta^{(l)})+\log\alpha_i^{(l)}\right)\right)\right]=0$$

$$q_{i1}=1-\sum_{s=1}^{N}\left[\frac{t_i(z_s,\theta^{(l)})}{\left[\left[\log\frac{a_i}{z_s}-\psi_0(q_{i1}-q_{i2}-2+1)+\psi_0(q_{i1}-1)\right]t_i(z_s,\theta^{(l)})\right]}\right] \qquad (8)$$

The updated equation of q_{i1} at $(l+1)$th iteration is

$$q_{i1}^{(l+1)}=1-\sum_{s=1}^{N}\left[\frac{t_i(z_s,\theta^{(l)})}{\left[\left[\log\frac{a_i}{z_s}-\psi_0(q_{i1}^{(l)}-q_{i2}^{(l)}-2+1)+\psi_0(q_{i1}^{(l)}-1)\right]t_i(z_s,\theta^{(l)})\right]}\right] \qquad (9)$$

For updating the parameter q_{i2} , i = 1, 2, …, K we consider the derivative of $Q\left(\theta;\theta^{(l)}\right)$ with respect to q_{i2} and equate it to zero. We have

$$Q\left(\theta;\theta^{(l)}\right)=E\left[\log L(\theta;\theta^{(l)})\right]$$

Therefore $\frac{\partial}{\partial q_{i2}}Q\left(\theta;\theta^{(l)}\right)=0$ implies $E\left[\frac{\partial\log L(\theta;\theta^{(l)})}{\partial q_{i2}}\right]=0$

$$\frac{\partial}{\partial q_{i2}}\left[\sum_{i=1}^{K}\sum_{s=1}^{N}\left(t_i(z_s,\theta^{(l)})\left(\log f_i(z_s,\theta^{(l)})+\log\alpha_i^{(l)}\right)\right)\right]=0$$

$$q_{i2}=\frac{\sum_{s=1}^{N}t_i(z_s,\theta^{(l)})}{\sum_{s=1}^{N}\left[\log\frac{(z_s-a_i)}{a_i}+\psi_0(q_{i1}-q_{i2}-2+1)-\psi_0(q_{i2})\right]t_i(z_s,\theta^{(l)})} \qquad (10)$$

The updated equation of q_{i2} at $(l+1)$th iteration is

$$q_{i2}^{(l+1)}=\frac{\sum_{s=1}^{N}t_i(z_s,\theta^{(l)})}{\sum_{s=1}^{N}\left[\log\frac{(z_s-a_i)}{a_i}+\psi_0(q_{i1}^{(l)}-q_{i2}^{(l)}-2+1)-\psi_0(q_{i2}^{(l)})\right]t_i(z_s,\theta^{(l)})} \qquad (11)$$

Where $t_i(z_s,\theta^{(l)})=\frac{\alpha_i^{(l)}f_i(z_s,\theta^{(l)})}{\sum_{i=1}^{K}\alpha_i^{(l)}f_i(z_s,\theta^{(l)})}$

IV. Initialization of the Parameters by K – Means and Hierarchical Algorithm

Generally the efficiency of the EM algorithm depends upon the count of the regions in the image, during the estimation of the parameters. The number of

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

mixture components taken for K – Means algorithm is, by plotting the histogram of the pixel intensities of the whole image. The number of peaks in the histogram can be taken as the initial value of the number of regions K.

The mixing parameters α_i and the model parameters q_{i1}, q_{i2} are usually considered as known apriori. Drawing a random sample from the entire image (Mclanchan G. and Peel D. (2000)) is the most commonly used method for initializing parameters. This method shows better performance, if the sample size is large and its computational time is heavily increased. When the sample size is small, there are some small regions which may not be sampled. To divide the whole image into various homogeneous regions we use the K – Means algorithm. In this algorithm the centroids of the clusters are recomputed as soon as the pixel joins a cluster.

a) K-Means Clustering Algorithm

It is one of the simplest clustering technique with a primary goal to find the partition of the data which minimizes the squared error or the sum of squared distances between all the points and their respective cluster centers (Rose H. Turi, (2001)). This K-means algorithm uses an iterative procedure and this procedure minimizes the sum of distances from each object to its cluster centroid, over all clusters. This procedure consists of the following steps.

1) Randomly choose K data points from the whole dataset as initial clusters. These data points represent initial cluster centroids.
2) Calculate Euclidean distance of each data point from each cluster centre and assign the data points to its nearest cluster centre.
3) Calculate new cluster centre so that squared error distance of each cluster should be minimum.
4) Repeat step 2 and 3 until clustering centers do not change.
5) Stop the process.

In the above algorithm, once only if all points have been allocated to their closed cluster centre then the cluster centers are updated. The advantage of this algorithm is that it is a very simple method, and based on intuition about the nature of a cluster, which is that the within cluster error should be as small as possible. The disadvantage of the K-Means algorithm is that the number of clusters must be supplied as a parameter, leading to the user having to decide what the best number of clusters for the image is (Rose H. Turi, (2001)). Success of K-means algorithm depends on the parameter K, number of clusters in image.

After determining the final values of K (number of regions) , we obtain the initial estimates of a_i, q_{i1}, q_{i2} and α_i for the i^{th} region using the segmented region pixel intensities with Pearson Type VI distribution .The initial estimate α_i is taken as $\alpha_i=1/K$, where i = 1,2,...,K. The parameters q_{i1} and q_{i2} are estimated by the method of moments as first moment μ_1 and its three central moments (μ_2, μ_3 and μ_4).

b) Hierarchical Clustering Algorithm

In order to utilize the EM algorithm we have to initialize the parameter α_i and the model parameters q_{i1}, q_{i2} which are generally considered as known apriori. The initial values of α_i can be taken as $\alpha_i=1/K$ where, K is the number of image regions obtained from the Hierarchical clustering algorithm (Marr D. et al (1980)). The steps involved in hierarchical clustering algorithm are as follows.

Step 1: Start by assigning each item to a segment. Each of the N items, are associated with N segments, each containing just one item. Let the distances (similarities) between the segments be the same as the distances (similarities) between the items they contain.

Step 2: Find the closest (most similar) pair of segments and merge them into a single segment. The number of segments is now reduced by one. Compute distances (similarities) between the new segments and each of the old segments.

Step 3: Repeat steps 2 and 3 until all items are segmented.

Step 3 can be done in different ways, namely i) Single-Linkage ii) Complete-Linkage and iii) Average-Linkage segmenting. We consider the Average - Linkage methodology. Average-Linkage segmenting (also called the unweighted pair-group method using arithmetic averages), is one of the most widely used hierarchical clustering algorithms. The average linkage algorithm is obtained by defining the distance between two segments to be the average distance between a point in one segment and a point in the other segment. The algorithm is an agglomerative scheme that erases rows and columns in the proximity matrix as old segments are merged into new ones.

The proximity matrix is $D = [d(i,j)]$. The segments are assigned sequence numbers $0,1.., (n-1)$ and $L(k)$ is the level of the K^{th} segment. A segment with a sequence number m is denoted by (m) and the proximity between segments (r) and (s) is denoted $d[(r), (s)]$. The algorithm is composed of the following steps: Begin with the disjoint segment having level $L(0) = 0$ and sequence number m = 0.

Find the average dissimilar pair of segments in the current segment, say pair $[(r), (s)]$,for all pairs of segments in the current segment.

1. Increment the sequence number: $m = m + 1$. Merge segments (r) and (s) into a single segment to form the next segmenting m. Set the level of this segmenting to $L(m) = d[(r), (s)]$.
2. Update the proximity matrix, D, by deleting the rows and columns corresponding to segments (r)

© 2014 Global Journals Inc. (US)

and (s) and adding a row and column corresponding to the newly formed segment. The proximity between the new segment, denoted (r, s) and old segment(K)is defined in this way.

$$d_{(r,s)\,K} = \frac{\sum_{i}\sum_{j} d(i,j)}{N_{(r,s)}\,N_{K}}$$

where *d(i, j)* is the distance between object i in the cluster *(r, s)* and object j in the cluster K, and $N_{(r,s)}$ and $N_{(k)}$ are the number of items in the clusters *(r, s)* and K respectively. The above procedure is repeated till the distance between two clusters is less than the specified threshold value.

We obtain the initial estimates of q_{i1}, q_{i2} and α_i for the i[th] region using the segmented region pixel intensities with the moment method given by Pearsonian Type VI distribution, only after determining the final values of K (number of regions). After getting these initial estimates, the final refined estimates of the parameters through EM algorithm given in section (III) is obtained.

V. Segmentation Algorithm

In this section, the characteristics of the image segmentation algorithm are projected. After refining the parameters, the first step in image segmentation is allocating the pixels to the segments of the image. This operation is performed by Segmentation Algorithm which consists of four steps.

Step 1: Plot the histogram of the whole image.

Step 2: Obtain the initial estimates of the model parameters using K-Means algorithm and moment estimates for each image region as discussed in section IV.

Step 3: Obtain the refined estimates of the model parameters q_{i1},q_{i2} and α_i for i=1, 2, ..., K using the EM algorithm with the updated equations given by (7), (9) and (11) respectively in section III.

Step 4: Assign each pixel into the corresponding j[th] region (segment) according to the maximum likelihood of the j[th] component L_j. That is

$$L_j = \max_{j \in k}\left[\frac{(z_s - a_i)^{q_{j2}}(z_s)^{-q_{j1}}}{(a_j)^{(q_{j2}-q_{j1}+1)}\beta(q_{j1}-q_{j2}-1, q_{j2}+1)}\right],$$

$$a_i \le z_i < \alpha \quad -\infty < q_{j1}, q_{j2} < \infty.$$

VI. Experimental Results

The performance of the developed a segmentation method for the natural images, which are considered on the earth. For implementing this algorithm, we need to initialize the model parameters, which are usually done by using moment method of estimations. Initially the feature vector is divided into different segmented regions by making use of non-parametric methods of segmentation namely K-means algorithm and Hierarchical clustering algorithms.

An experiment is conducted with four images taken from Berkeley images dataset (http:// www. eecs. berkeley.edu/Research/Projects/CS/Vision/bsds/BSDS300/html). The images FACE, EAGLE, NEST BIRD and TIGER, are considered for image segmentation in order to demonstrate the utility of the image segmentation algorithm. The pixel intensities of the whole image are taken as feature. The pixel intensities of the image are always assumed to follow a mixture of Pearson Type VI distribution.

That is, the image contains K regions and pixel intensities in each image region follow a Pearson Type VI distribution with different parameters. The number of segments in each of the four images considered for experimentation are determined by the histogram of pixel intensities. The histograms of the pixel intensities of the four images are shown in Figure 1.

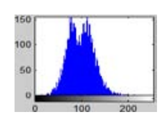
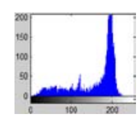
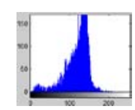
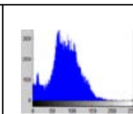
			
TIGER	EAGLE	NEST BIRD	FACE

Figure 1 : Histograms Of The Images

The initial estimates of the number of the regions K in each image are obtained and given in Table 1.

Table 1 : Initial Estimates Of K

IMAGE	TIGER	EAGLE	NEST BIRD	FACE
Estimate of K	2	3	4	4

From Table 1, we observe that the image TIGER has two segments, images EAGLE has three segments and images NEST BIRD AND FACE have four segments each. The initial values of the model parameters mi1,mi2, qi1,qi2 and αi for i = 1, 2, …, K , for each image region are computed by the method given in section III.

By making use of these initial estimates and the updated equations of the EM Algorithm given in Section III, the final estimates of the model parameters for each image are obtained and presented in Tables 2.a,2.b, 2.c, and 2.d for different images.

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

Table-2.a

Estimated Values Of The Parameters For TIGER Image Number of Image Regions (K =2)				
Parameters	Estimation of Initial Parameters		Estimation of Final Parameters by EM Algorithm	
	Image Region		Image Region	
	1-TYPEI	2-TYPEVI	1-TYPEI	2-TYPEVI
α_i	0.500	0.500	0.988622	0.011378
a_{i1}	-97.4751	a_i =453.1814	-0.00316	a_i =1
a_{i2}	26.96539	q_{i1} =1.061354	-7.3732	q_{i1} =1.06892
m_{i1}	0.783307	q_{i2} =0.061354	-11.0395	q_{i2} =0.062561
m_{i2}	-0.21669	-	-23.8409	-

Table-2.b

Estimated Values Of The Parameters For EAGLE Image Number of Image Regions (K =3)						
Parameters	Estimation of Initial Parameters			Estimation of Final Parameters by EM Algorithm		
	Image Region			Image Region		
	1-TYPEI	2-TYPEVI	3-TYPEI	1-TYPEI	2-TYPEVI	3-TYPEI
α_i	0.333	0.333	0.333	0.950792	0.00245	0.046758
a_{i1}	-42.6351	a_i =-829.883	-35.4287	0.004741	a_i =-4.01E-12	-1.2948
a_{i2}	38.46268	q_{i1} =1.027226	38.6806	-0.1653	q_{i1} =1.028736	14.15414
m_{i1}	0.525725	q_{i2} =0.027226	0.47806	0.225525	q_{i2} =0.027134	2.642036
m_{i2}	-0.47428	-	-0.52194	0.594823	-	0.405279

Table-2.c

Estimated Values Of The Parameters For NEST BIRD Image Number of Image Regions (K =4)								
Parameters	Estimation of Initial Parameters				Estimation of Final Parameters by EM Algorithm			
	Image Region				Image Region			
	1-TYPEI	2-TYPEVI	3-TYPEI	4-TYPEI	1-TYPEI	2-TYPEVI	3-TYPEI	4-TYPEI
α_i	0.250	0.250	0.250	0.250	-0.03459	0.002342	0.650132	0.382119
a_{i1}	-24.3208	a_i =181.3095	-15.9394	-30.2968	-1.38028	a_i =1	-0.215	-0.26305
a_{i2}	28.31176	q_{i1} =1.066072	11.42341	14.58499	12.98182	q_{i1} =1.073076	-0.19938	-0.68031
m_{i1}	0.462087	q_{i2} =0.066072	0.582521	0.675036	0.297129	q_{i2} =0.06951	2.420679	2.281604
m_{i2}	-0.53791	-	-0.41748	-0.32496	0.848453	-	0.469579	0.520931

© 2014 Global Journals Inc. (US)

Table-2.d

Parameters	Estimation of Initial Parameters				Estimation of Final Parameters by EM Algorithm			
Estimated Values Of The Parameters For FACE Image Number of Image Regions (K =4)								
	Image Region				Image Region			
	1-TYPEI	2-TYPEI	3-TYPEVI	4-TYPEI	1-TYPEI	2-TYPEI	3-TYPEVI	4-TYPEI
α_i	0.250	0.250	0.250	0.250	0.0068	0.9772	0.0078	0.0082
a_{i1}	-18.965	-24.176	a_i = -468.346	-16.528	20.6072	-0.1116	a_i =1.000	-2.290
a_{i2}	22.946	17.734	q_{i1} = 1.047	18.557	493.753	-0.3840	q_{i1} =-1.055	15.577
m_{i1}	0.4525	0.5768	q_{i2} = 0.0471	0.4710	-0.0283	2.4305	q_{i2} =0.0475	2.664
m_{i2}	-0.5474	-0.423	-	-0.5289	-0.0819	0.4662	-	0.3995

The probability density function of pixel intensities of each image is estimated by substituting the final estimates of the model parameters. The estimated probability density function of the pixel intensities of the image TIGER is

$$f(z_s,\theta^{(l)})=\frac{(0.988622)(-0.00316)^{(-11.04)}(-7.37)^{(-23.84)}\left(1+\frac{z_i}{-0.0032}\right)^{-11.04}\left(1-\frac{z_i}{-7.373}\right)^{-23.84}}{(-0.00316-7.3732)^{(-11.0395+-23.8409+1)}\beta(-11.0395+1,-23.841+1)}+\frac{(0.011378)(z_s-1.000)^{0.062561}(z_s)^{-1.06892}}{(1.000)^{(0.0626-1.06892+1)}\beta(1.06892-0.06256-1,0.0626+1)}$$

The estimated probability density function of the pixelintensities of the image EAGLE is

$$f(z_s,\theta^{(l)})=\frac{(0.950792)(0.005)^{(0.226)}(-0.1653)^{(0.5948)}\left(1+\frac{z_i}{0.005}\right)^{(0.226)}\left(1-\frac{z_i}{-0.1653}\right)^{(0.595)}}{(0.0047+-0.1653)^{(0.2255+0.5948+1)}\beta(0.225525+1,0.5948+1)}+\frac{(0.00245)(z_s-4.01E-12)^{0.062561}(z_s)^{1.028736}}{(4.01E-12)^{(0.027134-1.028736+1)}\beta(1.028736-0.027134-1,0.02713+1)}+\frac{(0.046758)(1.2948)^{(2.64204)}(14.154)^{(0.41)}\left(1+\frac{z_i}{1.2948}\right)^{(2.6421)}\left(1-\frac{z_i}{14.154}\right)^{(0.41)}}{(1.2948+14.154)^{(2.642036+0.405279+1)}\beta(2.642036+1,0.4053+1)}$$

The estimated probability density function of the pixel intensities of the image NEST BIRD is

$$f(z_s,\theta^{(l)})=\frac{(-0.03459)(-1.38)^{(0.29713)}(12.982)^{(0.8485)}\left(1+\frac{z_i}{-1.381}\right)^{(0.2971)}\left(1-\frac{z_i}{12.982}\right)^{(0.849)}}{(-1.38028+12.98182)^{(0.29713+0.8485+1)}\beta(0.2972+1,0.849+1)}+\frac{(0.002342)(z_s-1.000)^{0.06951}(z_s)^{1.073076}}{(1.000)^{(0.06951-1.073076+1)}\beta(0.06951-0.062561-1,0.06951+1)}+\frac{(0.650132)(-0.215)^{(2.421)}(-0.1994)^{(0.4696)}\left(1+\frac{z_i}{-0.215}\right)^{(2.4207)}\left(1-\frac{z_i}{-0.1994}\right)^{(0.469)}}{(-0.215-0.19938)^{(2.420679+0.4696+1)}\beta(2.420679+1,0.4696+1)}+\frac{(0.382119)(-0.2631)^{(2.282)}(-0.680)^{(0.521)}\left(1+\frac{z_i}{-0.263}\right)^{(2.282)}\left(1-\frac{z_i}{-0.68031}\right)^{(0.521)}}{(-0.26305-0.68031)^{(2.281604+0.520931+1)}\beta(2.281604+1,0.5209+1)}$$

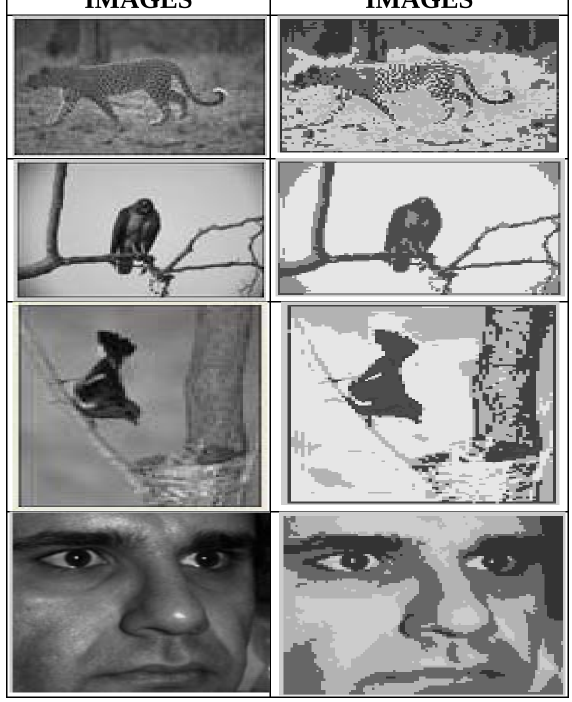
The estimated probability density function of the pixel intensities of the image FACE is

$$f(z_s,\theta^{(l)})=\frac{(0.0068)(20.61)^{(-0.0283)}(493.75)^{(-0.0819)}\left(1+\frac{z_i}{20.607}\right)^{(-0.028)}\left(1-\frac{z_i}{493.75}\right)^{(-0.082)}}{(20.6072+493.753)^{(-0.0283-0.0819+1)}\beta(-0.0283+1,-0.082+1)}+\frac{(0.9772)(-0.1116)^{(2.4305)}(-0.3840)^{(0.47)}\left(1+\frac{z_i}{-0.1116}\right)^{(2.431)}\left(1-\frac{z_i}{-0.384}\right)^{(0.47)}}{(-0.1116-0.3840)^{(2.4305+0.4662+1)}\beta(2.4305+1,0.4662+1)}+\frac{(0.0078)(z_s-1.000)^{0.0475}(z_s)^{1.055}}{(1.000)^{(0.0475-1.055+1)}\beta(1.055-0.0475-1,0.0475+1)}+\frac{(0.0082)(-2.29)^{(2.664)}(15.58)^{(0.3995)}\left(1+\frac{z_i}{-2.290}\right)^{(2.664)}\left(1-\frac{z_i}{15.58}\right)^{(0.3995)}}{(-2.290+15.58)^{(2.664+0.3995+1)}\beta(2.664+1,0.3995+1)}$$

Using the estimated probability density function and image segmentation algorithm given in section III, the image segmentation is done for the five images under consideration. The original and segmented images are shown in Figure 2

Figure 2 : *Original and Segmented Images*

ORIGINAL IMAGES	SEGMENTED IMAGES



Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

VII. Initialization of Parameters by Hierarchical Clustering Algorithm

In this section, we evaluate the efficiency of the proposed image segmentation algorithm. For this purpose of evaluation the images are collected from the Berkeley image data set. For this we need to randomly pick four images from the database and feature vector consisting of gray value for each pixel of the image. The feature vector in each image is modeled by using Pearsonian Type VI & Pearsonian Type I Distribution. By dividing all the pixel into different regions using Hierarchical Clustering Algorithm, the initial values of model parameters mi1, mi2, qi1,qi2 and αi are obtained. Using these values and the updated equations of EM- Algorithm discussed in section III with MATLAB code, the final values of the model parameters are calculated and presented in the tables 3.a, 3.b, 3.c and 3.d

Table-3.a

Estimated Values Of The Parameters For TIGER Image Number of Image Regions (K =2)				
Parameters	Estimation of Initial Parameters by Hierarchical clustering		Estimation of Final Parameters by EM Algorithm	
	Image Region		Image Region	
	1	2	1	2
α_i	0.500	0.500	2.01257	-1.01257
a_{i1}	-75.717	-11.7563	-1.6508	-0.0459
a_{i2}	82.970	740.670	88.3755	-28057.91
m_{i1}	0.4771	0.0156	0.6101	40.2429
m_{i2}	-0.5228	-0.9843	1.7071	0.01562

Table-3.b

Estimated Values Of The Parameters For EAGLE Image Number of Image Regions (K =3)						
Parameters	Estimation of Initial Parameters by Hierarchical clustering			Estimation of Final Parameters by EM Algorithm		
	Image Region			Image Region		
	1	2	3	1	2	3
α_i	0.333	0.333	0.333	0.4574	0.1921	0.3503
a_{i1}	-29.580	-99.0809	-41.2789	-0.1968	0.6095	-0.05994
a_{i2}	22.567	14.1523	35.7243	-0.7845	-0.70016	-1.0802
m_{i1}	0.5672	0.87501	0.53606	0.26831	2.08306	2.50880
m_{i2}	-0.4327	-0.1249	-0.4639	0.67742	0.61615	0.44170

Table-3.c

Estimated Values Of The Parameters For NEST BIRD Image Number of Image Regions (K =4)								
Parameters	Estimation of Initial Parameters by Hierarchical clustering				Estimation of Final Parameters by EM Algorithm			
	Image Region				Image Region			
	1	2	3	4	1	2	3	4
α_i	0.250	0.250	0.250	0.25	0.8124	0.6205	-0.1252	-0.3077
a_{i1}	-29.742	-42.662	-22.721	-13.326	-0.39174	-0.2174	-0.5579	-0.0467
a_{i2}	22.299	18.108	27.072	75.188	-0.8320	-0.7572	17.451	1018.7
m_{i1}	0.5715	0.7020	0.4563	0.1506	0.31705	2.2480	2.7025	5.3865
m_{i2}	-0.4284	-0.2979	-0.5436	-0.8494	0.7971	0.5349	0.3905	0.14647

© 2014 Global Journals Inc. (US)

Table-3.d

Estimated Values Of The Parameters For FACE Image Number of Image Regions (K =4)								
Parameters	Estimation of Initial Parameters by Hierarchical clustering				Estimation of Final Parameters by EM Algorithm			
	Image Region				Image Region			
	1	2	3	4	1	2	3	4
α_i	0.250	0.250	0.250	0.250	0.3736	0.2847	0.2526	0.0891
a_{i1}	-12.244	-12.556	-14.509	-68.801	-0.0611	-0.1155	-0.0811	1.5517
a_{i2}	71.505	11.0781	9.1209	57.659	2536.35	0.3296	0.1468	-5.4401
m_{i1}	0.1462	0.5312	0.6140	0.544	-0.3232	2.5188	2.3684	2.4925
m_{i2}	- 0.8537	-0.4687	-0.3859	-0.4559	-2.3224	0.4387	0.4876	0.4465

Substituting the final estimates of the model parameters, the probability density function of pixel intensities of each image is estimated.

The estimated probability density function of the pixel intensities of the image TIGER is

$$f\left(z_s,\theta^{(l)}\right)=\frac{(2.01257)(\text{-}1.6508)^{(0.6101)}(88.3755)^{(1.7071)}\left(1+\frac{z_i}{\text{-}1.6508}\right)^{(0.6101)}\left(1-\frac{z_i}{88.3755}\right)^{(1.7071)}}{(\text{-}1.6508+88.3755)^{(0.6101+1.7071+1)}\beta(0.6101+1,1.7071+1)}$$
$$+\frac{(\text{-}1.01257)(\text{-}0.0459)^{(40.2429)}(\text{-}28057.91)^{(0.01562)}\left(1+\frac{z_i}{\text{-}0.0459}\right)^{(40.2429)}\left(1-\frac{z_i}{\text{-}28057.91}\right)^{(0.01562)}}{(\text{--}0.0459+\text{-}28057.91)^{(40.2429+0.01562+1)}\beta(40.2429+1,0.01562+1)}$$

The estimated probability density function of the pixel intensities of the image EAGLE is

$$f\left(z_s,\theta^{(l)}\right)=\frac{(0.4574)(\text{-}0.1968)^{(0.2683)}(\text{-}0.7845)^{(0.6774)}\left(1+\frac{z_i}{\text{-}0.1968}\right)^{(0.2683)}\left(1-\frac{z_i}{\text{-}0.7845}\right)^{(0.6774)}}{(\text{-}0.1968+\text{-}0.7845)^{(0.26831+0.6774+1)}\beta(0.26831+1,0.6774+1)}$$
$$+\frac{(0.1921)(0.6095)^{(2.0831)}(\text{-}0.70016)^{(0.6162)}\left(1+\frac{z_i}{0.6095}\right)^{(2.0831)}\left(1-\frac{z_i}{\text{-}0.70016}\right)^{(0.6162)}}{(0.6095+\text{-}0.70016)^{(2.08306+0.61615+1)}\beta(2.08306+1,0.6162+1)}$$
$$+\frac{(0.3503)(\text{-}0.05994)^{(2.5088)}(\text{-}1.0802)^{(0.442)}\left(1+\frac{z_i}{\text{-}0.05994}\right)^{(2.5088)}\left(1-\frac{z_i}{\text{-}1.0802}\right)^{(0.4417)}}{(\text{-}0.05994+\text{-}1.0802)^{(2.5088+0.4417+1)}\beta(2.5088+1,0.4417+1)}$$

The estimated probability density function of the pixel intensities of the image NEST BIRD is

$$f\left(z_s,\theta^{(l)}\right)=\frac{(0.8124)(\text{-}0.39174)^{(0.31705)}(\text{-}0.8320)^{(0.7971)}\left(1+\frac{z_i}{\text{-}0.39174}\right)^{(0.31705)}\left(1-\frac{z_i}{\text{-}0.8320}\right)^{(0.7971)}}{(\text{-}0.39174+\text{-}0.8320)^{(0.31705+0.7971+1)}\beta(0.31705+1,0.7971+1)}$$
$$+\frac{(0.6205)(\text{-}0.2174)^{(2.2480)}(\text{-}0.7572)^{(0.5349)}\left(1+\frac{z_i}{\text{-}0.2174}\right)^{(2.2480)}\left(1-\frac{z_i}{\text{-}0.7572}\right)^{(0.5349)}}{(\text{-}0.2174+\text{-}0.7572)^{(2.2480+0.5349+1)}\beta(2.2480+1,0.5349+1)}$$
$$+\frac{(\text{-}0.1252)(\text{-}0.5579)^{(2.7025)}(17.4509)^{(0.39047)}\left(1+\frac{z_i}{\text{-}0.5579}\right)^{(2.7025)}\left(1-\frac{z_i}{17.4509}\right)^{(0.39047)}}{(\text{-}0.5579+17.4509)^{(2.7025+0.39047+1)}\beta(2.7025+1,0.39047+1)}$$
$$+\frac{(\text{-}0.30771)(\text{-}0.04669)^{(5.3865)}(1018.7)^{(0.14647)}\left(1+\frac{z_i}{\text{-}0.04669}\right)^{(5.3865)}\left(1-\frac{z_i}{1018.7}\right)^{(0.14647)}}{(\text{-}0.04669+1018.7)^{(5.3865+0.14647+1)}\beta(5.3865+1,0.14647+1)}$$

The estimated probability density function of the pixel intensities of the image BIRD is

$$f\left(z_s,\theta^{(l)}\right)=\frac{(\text{-}0.6508)(\text{-}0.2402)^{(4.1042)}(1504.84)^{(13.844)}\left(1+\frac{z_i}{\text{-}0.2402}\right)^{(4.1042)}\left(1-\frac{z_i}{1504.84}\right)^{(13.844)}}{(\text{-}0.2402+1504.84)^{(4.1042+13.844+1)}\beta(4.1042+1,13.844+1)}$$
$$+\frac{(\text{-}0.2327)(\text{-}0.1752)^{(2.9874)}(\text{-}622.13)^{(0.3331)}\left(1+\frac{z_i}{\text{-}0.1752}\right)^{(2.9874)}\left(1-\frac{z_i}{\text{-}622.13}\right)^{(0.3331)}}{(\text{-}0.1752+\text{-}622.13)^{(2.9874+0.3331+1)}\beta(2.9874+1,0.3331+1)}$$
$$+\frac{(0.7248)(\text{-}96.5481)^{(2.3041)}(\text{-}5.9734)^{(0.51185)}\left(1+\frac{z_i}{\text{-}96.5481}\right)^{(2.3041)}\left(1-\frac{z_i}{\text{-}5.9734}\right)^{(0.51185)}}{(\text{-}96.5481+\text{-}5.9734)^{(2.3041+0.51185+1)}\beta(2.3041+1,0.51185+1)}$$
$$+\frac{(1.1587)(\text{-}0.3530)^{(2.34037)}(\text{-}0.7436)^{(0.4979)}\left(1+\frac{z_i}{\text{-}0.3530}\right)^{(2.34037)}\left(1-\frac{z_i}{\text{-}0.7436}\right)^{(0.4979)}}{(\text{-}0.3530+\text{-}0.7436)^{(2.34037+0.4979+1)}\beta(2.34037+1,0.4979+1)}$$

$$f\left(z_s,\theta^{(l)}\right)=\frac{(\text{-}0.6508)(\text{-}0.2402)^{(4.1042)}(1504.84)^{(13.844)}\left(1+\frac{z_i}{\text{-}0.2402}\right)^{(4.1042)}\left(1-\frac{z_i}{1504.84}\right)^{(13.844)}}{(\text{-}0.2402+1504.84)^{(4.1042+13.844+1)}\beta(4.1042+1,13.844+1)}$$
$$+\frac{(\text{-}0.2327)(\text{-}0.1752)^{(2.9874)}(\text{-}622.13)^{(0.3331)}\left(1+\frac{z_i}{\text{-}0.1752}\right)^{(2.9874)}\left(1-\frac{z_i}{\text{-}622.13}\right)^{(0.3331)}}{(\text{-}0.1752+\text{-}622.13)^{(2.9874+0.3331+1)}\beta(2.9874+1,0.3331+1)}$$
$$+\frac{(0.7248)(\text{-}96.5481)^{(2.3041)}(\text{-}5.9734)^{(0.51185)}\left(1+\frac{z_i}{\text{-}96.5481}\right)^{(2.3041)}\left(1-\frac{z_i}{\text{-}5.9734}\right)^{(0.51185)}}{(\text{-}96.5481+\text{-}5.9734)^{(2.3041+0.51185+1)}\beta(2.3041+1,0.51185+1)}$$
$$+\frac{(1.1587)(\text{-}0.3530)^{(2.34037)}(\text{-}0.7436)^{(0.4979)}\left(1+\frac{z_i}{\text{-}0.3530}\right)^{(2.34037)}\left(1-\frac{z_i}{\text{-}0.7436}\right)^{(0.4979)}}{(\text{-}0.3530+\text{-}0.7436)^{(2.34037+0.4979+1)}\beta(2.34037+1,0.4979+1)}$$

The estimated probability density function of the pixel intensities of the image FACE is

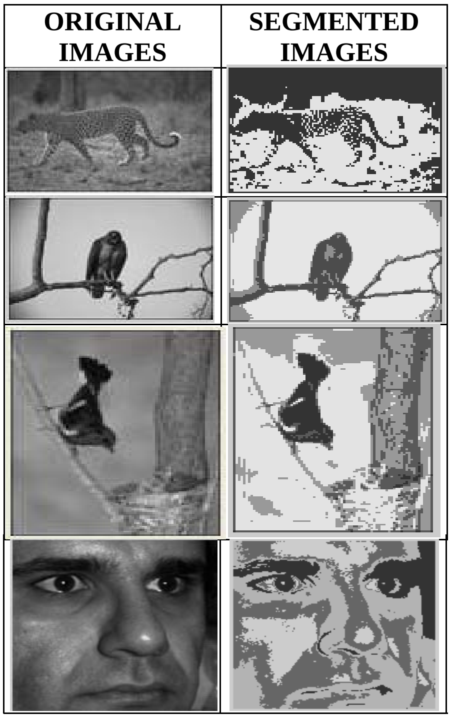
$$f\left(z_s,\theta^{(l)}\right)=\frac{(0.3736)(\text{-}0.0611)^{(\text{-}0.3232)}(2536.35)^{(1.0010)}\left(1+\frac{z_i}{\text{-}0.0611}\right)^{(\text{-}0.3232)}\left(1-\frac{z_i}{2536.35}\right)^{(1.0010)}}{(\text{-}0.0611+2536.35)^{(\text{-}0.3232+1.0010+1)}\beta(\text{-}0.3232+1,1.0010+1)}$$
$$+\frac{(0.2847)(\text{-}0.1155)^{(2.5188)}(0.3296)^{(0.4387)}\left(1+\frac{z_i}{\text{-}0.1155}\right)^{(2.5188)}\left(1-\frac{z_i}{0.3296}\right)^{(0.4387)}}{(\text{-}0.1155+0.3296)^{(2.5188+0.4387+1)}\beta(2.5188+1,0.4387+1)}$$
$$+\frac{(0.2526)(\text{-}0.0811)^{(2.3684)}(0.1468)^{(0.4876)}\left(1+\frac{z_i}{\text{-}0.0811}\right)^{(2.3684)}\left(1-\frac{z_i}{0.1468}\right)^{(0.4876)}}{(\text{-}0.0811+0.1468)^{(2.3684+0.4876+1)}\beta(2.3684+1,0.4876+1)}$$
$$+\frac{(0.0891)(1.5517)^{(2.4925)}(\text{-}5.4401)^{(0.4465)}\left(1+\frac{z_i}{1.5517}\right)^{(2.4925)}\left(1-\frac{z_i}{\text{-}5.4401}\right)^{(0.4465)}}{(1.5517+\text{-}5.4401)^{(2.4925+0.4465+1)}\beta(2.4925+1,0.4465+1)}$$

Using the estimated probability density function and image segmentation algorithm given in section V, the image segmentation is done for the four images under consideration. The original and segmented images are shown in Figure 3.

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

Figure 3 : Original and Segmented Images



VIII. Performance Evalution

In this paper we have conducted the experiment and also examined its performance by making use of the image segmentation algorithm. The performance evaluation of this segmentation technique is carried by obtaining the three performance measures namely, (i) probabilistic rand index (PRI), (ii) global consistence error (GCE) and (iii) variation of information (VOI). By computing the segmentation performance measures namely VOI, PRI and GCE for the five images under study using Pearsonian Type VI Distribution (PTVID-K), the performance of the developed algorithm is studied. The computed values of the performance measures for the developed algorithm and the earlier existing finite Gaussian mixture model(GMM) with K-means algorithm and Hierarchical algorithm are presented in Table 4 for a comparative study.

Table 4 : Segmentation Performace Measures

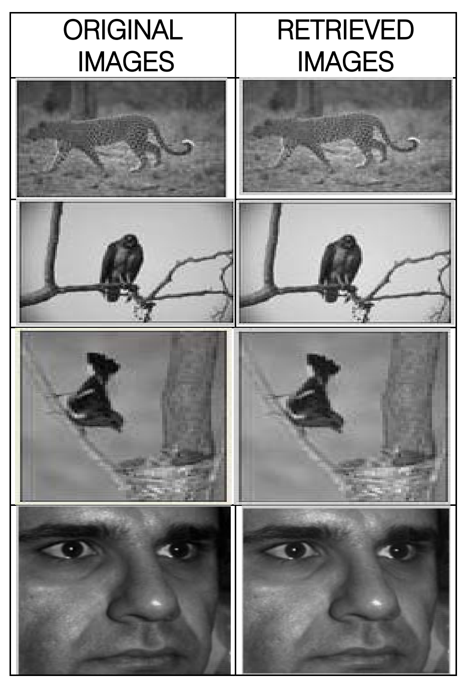
IMAGES	METHOD	PERFORMANCE MEASURES		
		PRI	GCE	VOI
TIGER	GMM	0.8234	0.4956	2.568
	PTVID-K	0.9896	0.4742	1.921
	PTVID-H	0.9897	0.4762	1.920
EAGLE	GMM	0.8423	0.7006	8.354
	PTVID-K	0.8505	0.7109	7.577
	PTVID-H	0.8627	0.7054	7.2002
NEST BIRD	GMM	0.9793	0.9142	8.8837
	PTVID-K	0.0258	0.0124	6.7136
	PTVID-H	0.0074	0.0001	7.2132
FACE	GMM	0.0201	0.0891	7.2546
	PTVID-K	0.0223	0.0134	7.1556
	PTID-K	0.9559	0.8584	8.8772

From Table 4 it is identified that the PRI values of the existing algorithm based on finite Gaussian Mixture model for the five images considered for experimentation are less than the values from the segmentation algorithm based Pearsonian Type VI Distribution with K-means. Similarly GCE and VOI values of the proposed algorithm are less than that of finite Gaussian mixture model. This reveals the fact that the proposed algorithm outperforms the existing algorithm based on the finite Gaussian mixture model.

After developing the image segmentation method , it is required to verify the utility of segmentation in model building of the image for image retrieval. By subjective image quality testing or by objective image quality testing the performance evaluation of the retrieved image can be done. Since the numerical results of an objective measure allow a consistent comparison of different algorithms the objective image quality testing methods are often used. There are several image quality measures available for performance evaluation of the image segmentation method. An extensive survey of quality measures is given by Eskicioglu A.M. and Fisher P.S. (1995).

Using the estimated probability density functions of the images under consideration the retrieved images are obtained and are shown in Figure 4.

Figure 4 : The Original and Retrieved Images



© 2014 Global Journals Inc. (US)

For the above retrieved images FACE, NEST BIRD AND EAGLE The calculated image quality measures using proposed PTVID and GMM with K-means and Hierarchical algorithm are displayed in the Table 5.

Table 5 : Comparative Study of Image Quality Metrics

IMAGE	Quality Metrics	GMM	PTVID -K	PTVID- H	Standard Limits
TIGER	Average Difference	0.4837	0.4203	0.4193	Close to 0
	Maximum Distance	1.0000	1.000	1.0000	Close to 1
	Image Fidelity	1.0000	1.0000	0.99996	Close to 1
	Mean Square Error	0.6011	0.4103	0.4100	Close to 0
	Signal to Noise Ratio	6.6542	6.0885	6.6416	As big as possible
	Image Quality Index	1.0000	1.0025	1.0025	Close to 1
EAGLE	Average Difference	0.5946	0.5141	0.4538	Close to 0
	Maximum Distance	1.0000	1.0000	1.0000	Close to 1
	Image Fidelity	1.0000	0.9717	0.8628	Close to 1
	Mean Square Error	0.4946	0.3487	0.2367	Close to 0
	Signal to Noise Ratio	5.6828	11.1517	15.1083	As big as possible
	Image Quality Index	1.0000	0.9051	0.673046	Close to 1
NEST BIRD	Average Difference	0.4930	0.4094	0.3773	Close to 0
	Maximum Distance	1.0000	1.0000	1.0000	Close to 1
	Image Fidelity	1.0000	0.9136	0.856846	Close to 1
	Mean Square Error	0.4930	0.4453	0.3783	Close to 0
	Signal to Noise Ratio	5.6897	13.8803	14.1535	As big as possible
	Image Quality Index	1.0011	0.7311	0.571059	Close to 1
FACE	Average Difference	0.579	0.3170	0.2217	Close to 0
	Maximum Distance	1.0000	1.0000	1.0000	Close to 1
	Image Fidelity	1.0000	0.5703	0.6804	Close to 1
	Mean Square Error	0.5079	0.4556	0.1652	Close to 0
	Signal to Noise Ratio	5.6251	19.6707	20.7562	As big as possible
	Image Quality Index	1.0007	0.0366	0.0336	Close to 1

It is perceived that all the image quality measures for the five images are meeting the standard criteria as given in the Table 5. Basing on the above mentioned quality metrics we can retrieve images accurately by using the proposed algorithm. A comparative study is done on the algorithm based on finite Gaussian mixture model with the proposed algorithm and it reveals that the MSE of the proposed model is less than that of the finite Gaussian mixture model. The performance of the proposed model in retrieving the images is better than the finite Gaussian mixture model by making use of these quality metrics.

IX. Conclusion

In this paper, by using finite mixture of Pearsonian Type VI distribution a new model image segmentation is introduced and analyzed. The pixel intensities of animal images better characterizes the mixture of Pearsonian Type VI distribution which is validated through experiment with Berkeley image data set. The model parameters are estimated by using the EM Algorithm. By using the Maximum Likelihood estimates, the Segmentation Algorithm is developed under Bayesian framework. The Experiment on the Berkeley image data set reveals that this image segmentation method outperforms in segmenting the animal images then that of the existing algorithm basing on Gaussian mixture model with respect to image segmentation quality metrics such as PRI, GCE and VOI. The proposed algorithm is much useful for image analysis and image retrievals. The image that is developed can be extended with a K-dimensional feature vector for color images which will be takes as elsewhere.

References Références Referencias

1. Cheng et al (2001) "Color Image Segmentation: Advances and Prospects" Pattern Recognition, Vo1.34, pp. 2259-2281.
2. Eskicioglu M.A. and Fisher P.S. (1995) "Image Quality Measures and their Performance", IEEE Transactions On Communications, Vol.43, No.12, pp.2959-2965.
3. Gvs Rajkumar, K.Srinivasa Rao, And P.Srinivasa Rao-(2011)-Image Segmentation and Retrievals based on Finite Doubly Truncated Bivariate Gaussian Mixture Model and K-Means, "Accepted for Publication" in International Journal of Computer Applications (IJCA) , Vol. 25, No. 4, pp 5-13.
4. Jahne (1995), " A Practical Hand Book on Image segmentation for Scientific Applications, CRC Press.
5. Kelly P.A. et al (1998), "Statistical approach to X-ray CT imaging and its applications in image analysis", IEEE Trans. Med. Imag.,Vol.11, No.1, pp. 53-61.
6. Lei T. et al (2003), "Performance Evaluation of Finite Normal Mixture Model –Based Image

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

Segmentation Techniques", IEEE Transactions On Image Processing, Vol-12, No.10, pp. 1153-1169.

7. Mantas Paulinas and Andrius Usinskas (2007), "A survey of genentic algorithms applications for image enhancement and segmentation", Information Technology and control, Vol.36, No.3, pp. 278-284.
8. Marr D. et al (1980), "Theory of Edge Detection" Proceedings of Royal Society London, B207, pp. 187-217.
9. M. Seshashayee, K. Srinivasa Rao, Ch. Satyanarayana And P.Srinivasa Rao- (2011) -Image Segmentation Based on a Finite Generalized New Symmetric Mixture Model with K – Means, International journal of Computer Science Issues,Vol.8, No.3, pp.324-331.
10. M. Seshashayee, K. Srinivasa Rao, Ch.Satyanarayana And P.Srinivasa Rao- (2011) – Studies on Image Segmentation method Based on a New Symmetric Mixture Model with K – Means, Global journal of Computer Science and Technology, Vol.11, No.18, pp.51-58.
11. Mclanchan G. and Peel D. (2000)), "The EM Algorithm For Parameter Estimations ", John Wiley and Sons, New York.
12. Meila (2005), "Comparing Clustering – An axiomatic view", in proceedings of the 22nd International Conference on Machine Learning, pp. 577-584.
13. Nasios N. and Bors A.G. (2006), "Variational learning for Gaussian Mixtures", IEEE Transactions on Systems, Man and Cybernetics, Part B : Cybernetics, Vol.36(4), pp. 849-862.
14. Pal S.K. and Pal N.R. (1993), "A Review On Image Segmentation Techniques", Pattern Recognition, Vol.26, No.9, pp. 1277-1294.
15. P.V.G.D.Prasad Reddy, K. Srinivasa Rao And Srinivas Yerramalle-(2007), supervised image segmentation using finite Generalized Gaussian mixture model with EM & K-Means algorithm, International Journal of Computer Science and Network Security, Vol. 7, No.4. Pp. 317-321.
16. P.V.G.D.Prasad Reddy, K. Srinivasa Rao And Srinivas Yerramalle-(2007), supervised image segmentation using finite Generalized Gaussian mixture model with EM & K-Means algorithm, International Journal of Computer Science and Network Security, Vol. 7, No.4. Pp. 317-321.
17. Srinivas Y. et al (2007), "Unsupervised Image Segmentation based on Finite Doubly Truncated Gaussian Mixture model with K-Means algorithm", International Journal of Physical Sciences, Vol. 19, pp. 107-114.
18. Shital Raut et al (2009), "Image segmentation- A State-Of-Art survey for Prediction", International conference on Adv. Computer control, pp.420-424.
19. Srinivas Yerramalle, K .Srinivasa Rao, P.V.G.D.Prasad Reddy-(2010), Unsupervised image segmentation using generalized Gaussian distribution with hierarchical clustering, Journal of advanced research in computer engineering, Vol.4, No.1 pp. 43-51.
20. Srinivas Yerramalle And K .Srinivasa Rao (2007), Unsupervised image classification using finite truncated Gaussian mixture model, Journal of Ultra Science for Physical Sciences, Vol.19, No.1, pp 107-114.
21. Rose H. Turi, (2001)," Cluster Based Image Segmentation", Ph.d Thesis, Monash University, Australia.

© 2014 Global Journals Inc. (US)

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 14 Issue 3 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Emotion Profiling: Ingredient for Rule based Emotion Recognition Engine

By Dr. Preeti Khanna & Dr. Sasi M Kumar
SVKMs NMIMS - School of Business Management, India

Abstract- Emotions are considered to be the reflection of human thinking and decision-making process which increase his/her performance by producing an intelligent outcome. Hence it is a challenging task to embed the emotional intelligence in machine as well so that it could respond appropriately. However, present human computer interfaces still don't fully utilize emotion feedback to create a more natural environment because the performance of the emotion recognition is still not very robust and reliable and far from real life experience. In this paper, we present an attempt in addressing this aspect and identifying the major challenges in the process. We introduce the concept of 'emotion profile' to evaluate an individual feature as each feature irrespective of the modality has different capability for differentiating among the various subsets of emotions. To capture the discrimination across target emotions w.r.t. each feature we propose a framework for emotion recognition built around if-then rules using certainty factors to represent uncertainty and unreliability of individual features.

Keywords: human computer interaction; emotion; rule based system; emotion profile; multimodalities.

GJCST-F Classification : I.7.5 , I.4.0

EMOTIONPROFILINGINGREDIENTFORRULEBASEDEMOTIONRECOGNITIONENGINE

Strictly as per the compliance and regulations of:

© 2014. Dr. Preeti Khanna & Dr. Sasi M Kumar. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction inany medium, provided the original work is properly cited.

Emotion Profiling: Ingredient for Rule based Emotion Recognition Engine

Dr. Preeti Khanna [α] & Dr. Sasi M Kumar [σ]

Abstract- Emotions are considered to be the reflection of human thinking and decision-making process which increase his/her performance by producing an intelligent outcome. Hence it is a challenging task to embed the emotional intelligence in machine as well so that it could respond appropriately. However, present human computer interfaces still don't fully utilize emotion feedback to create a more natural environment because the performance of the emotion recognition is still not very robust and reliable and far from real life experience. In this paper, we present an attempt in addressing this aspect and identifying the major challenges in the process. We introduce the concept of 'emotion profile' to evaluate an individual feature as each feature irrespective of the modality has different capability for differentiating among the various subsets of emotions. To capture the discrimination across target emotions w.r.t. each feature we propose a framework for emotion recognition built around if-then rules using certainty factors to represent uncertainty and unreliability of individual features. This technique appears to be simple and effective for these kind of problems.

Keywords: human computer interaction; emotion; rule based system; emotion profile; multimodalities.

I. Introduction

The difference between machine and human is not only that a human being is intelligent but also that he/she is emotional (Marinez-Miranda et al., 2005). The emotions enable human to interact intelligently and effectively with other humans. Same concept could be extended to human computer interaction (HCI). It deals with various procedures and methods through which humans interact with computer. According to Foley (1996) HCI is a socio-technological discipline whose goal is to bring computer and communication system to society and its people in such a way that both become accessible and hence useful in working, learning, communicating and recreational lives (Foley, 1996). The study related to HCI draws from supporting knowledge on both the machine and the human side. On the machine side computer graphics, operating systems, and programming languages are relevant while on the human side communication, social sciences, cognitive psychology, and human performance are relevant. As computers become more pervasive in culture, researchers are increasingly looking for new and innovative ways to design these interfaces more interactive and efficient. By embedding emotions in the interaction of human with machine, machine would be in a position to sense the mood of the user and change its interaction accordingly. The system will be friendlier to the user and its responses will be more similar to human behavior. Motivations for emotional computing are manifold. From a scientific point of view, emotions play an essential role in decision making, as well as in perception and learning. Emotions influence various cognitive processes of people (Lisetti & Nasoz, 2005) including perception and organization of memory (Bower, 1981), categorization and preference (Zajonc, 1984), goal generation, evaluation, and decision-making (Damasio, 1994), strategic planning (Ledoux, 1992), focus and attention (Derryberry & Tucker, 1992), motivation and performance (Colquitt et al., 2000), intention (Frijda, 1986), communication (Birdwhistle, 1970; Ekman & Friesen, 1975; Chovil, 1991), and learning (Goleman, 1995). A common everyday task is driving, and yet research suggests that people emote while driving and their driving is affected by their emotions (James & Nahl, 2000). The inability to control one's emotions while driving is often identified as one of the major causes for accidents. Also by knowing the user's emotions, computer agents can become more effective in tutoring. A computer agent can learn the student's preferences and offer better interactions. Surveillance is another application domain in which the reading of emotions may lead to better performance in predicting the future actions of subjects. In this way, the emotion driven technology can enhance the existing systems for the identification and prevention of terrorist attacks in public places. Certainly not all computes need to pay attention to emotions, or have emotional abilities. Some machines are useful as rigid tools, and it is fine to keep them that way.

The paper begins by identifying the challenges in problem domain of emotion recognition. A complete framework of emotion recognition using rule based approach independent of any modalities (like speech or facial expressions) is then introduced. Core of this approach is feature analysis which has been explored using 'emotion profiling'. Finally the whole approach of rule based emotion recognition has been implemented using a running case scenario of facial expressions. Finally the performances of recognizing the target emotions have been reported. We conclude the paper by summarizing the results and consider some challenges facing the researchers in this area.

Author α σ: e-mails: preeti.khanna@nmims.edu, pkhanna0578@gmail.com, the.little.sasi@gmail.com

© 2014 Global Journals Inc. (US)

II. Emotion Recognition is Challenging!

Research related to emotion recognitions is tough because understanding emotion is difficult. To address the problem of emotion recognition various modalities like speech (Khanna & Kumar, 2010; Khanna & Kumar, 2011), facial expression, gesture, keyboard interaction (Khanna & Kumar, 2010), etc. had been explored. Some of the major challenges in this domain are as follows.

a) Choice of Features

The number of features used in the process of recognizing emotions from different modalities varies and depends on the application. Having a large number of features increases the complexity of the system, normally results in longer system training time and demand rich set of training data. Hence selection of features is a critical task.

b) Choice of Machine Learning Techniques

Depending on the context and the type of data, the classification algorithms used for emotion recognition have been constantly evolving in course of time. Various recognition methods have been used in the literature. One major dimension for variability among algorithms is the nature of knowledge representation used by these algorithms.

c) Emotional Database Issues

Data is of utmost importance. Having an appropriate database that is collected with a particular application and target user profile in mind can be expected to minimize the confusions that occur while organizing and labeling the emotional database. For example issues like emotion elicitation method (i.e., whether the elicited emotion displays are posed or spontaneous), size (the number of subjects), modality (audio, visual, etc.), emotion description (category or dimension), and labeling scheme is tedious job. Hence choice of database is another concern.

d) Choice of Emotions

This requires identification of the emotional states which have a bearing on HCI. It is not important to track all variants of emotion as a principle. Literature defines various subsets of emotions based on desired granularity and other parameters. Researchers still do not agree on what an emotion is and many of them do not consider a specific subset of emotions as 'basic set'. Hence defining and identifying the emotional state is a challenge.

e) Choice of Modalities and Fusion

The studies show multiple different modalities as the source for emotion like face, voice, gesture, etc. The accuracy of recognition from different sources may vary with time, for example, facial expression recognition is dependent on the system getting an adequate frontal view under good illumination. But in reality, one uses a combination of all these and they do not exist independently. Indeed, at times, the signals from the different sources may conflict each other, indicating different emotional states. However, most of the time the different sources provide additional information reinforcing the estimates made using one source and thus in determining the states with better confidence. Given the difficulties in mapping emotional states to recognizable characteristics in the various individual modalities, it becomes important to use multiple sources together. Picard (1997) observes that affect recognition is most accurate when it combines multiple modalities, information about the user's context, situation, goal, and preferences. But too much information from different modalities simultaneously seems to be confusing for human judges (Picard, 1997). Does this pertain in HCI too, needs to be addressed?

Hence due to multimodalities, problems related to data fusion are common. Humans simultaneously employ modalities of sight and sound. Does this tight coupling persist when the modalities are used for human behavior analysis, as suggested by some researchers, or not, as suggested by others? Does this depend on the machine learning techniques employed? In literature, some attempts like (De Silva & Ng, 2000), (Sebe et al., 2006) and (Zeng et al., 2007) have considered the integration of information from facial expressions and speech. Kim and Andre (2006) concentrated on the integration of physiological signals and speech signals for emotion recognition based on short term observation (Kim & Andre, 2006). In general there are two broad approaches which combine the inputs from different sources- feature based fusion and decision based fusion. Feature based fusion involves simply merging the features of each modality into a single feature vector. Decision based fusion is based on the fusion of decisions from each modality where the input coming from each modality is processed independently and these results are combined at the end. Several works like (Corradini et al., 2003), (Liao, 2002), (Kettebekov & Sharma, 2000), and (Sharma, 1998) discussed many issues and techniques of multimodal fusion. Finding an optimal fusion type for a particular combination of modalities is not straightforward. Hybrid fusion attempts to combine the benefits of both feature level and decision level fusion method. This may be a good choice for some multimodal fusion problems. However, based on existing knowledge and methods, how to combine the information coming from different modalities for the target set of emotions is still an open problem. In this paper we propose a rule based approach to recognize target emotions. This approach remains independent of modalities (speech or facial expressions or others).

© 2014 Global Journals Inc. (US)

III. Rule based Approach

A rule based system, in general, consists of if-then rules, a bunch of facts, and an interpreter controlling the application of the rules. One of the major strength of rule based representation is its ability to represent various uncertainties. Uncertainty is inherently part of most human decision making. This uncertainty could arise from various sources like incomplete data or domain knowledge used being unreliable. If – then rules is often represented like 'If A, B, C ----> then D, with certainty 'X', where X represents the degree of belief or confidence in the rule (Kumar et al., 2007). To handle uncertainties, there are two broad approaches, those representing uncertainty using numerical quantities and those using symbolic methods. For example, Bayesian reasoning (Shortliffe & Buchanan, 1975), Evidence theory (Gordon & Shortliffe, 1984) and Fuzzy set approaches (Negoita, 1985) are numerical models. On the other hand, symbolic characterization of uncertainty is mostly aimed at handling incomplete information, for example Assumption Based Reasoning (Doyle, 1979), Default Reasoning (Reiter, 1980) and Non-monotonic Logic (McDermott & Doyle, 1980). In our domain, the basic problem is that there are hardly any feature or feature combinations which can infer any emotion to complete certainty. Therefore, we concentrate on numerical approaches for handling the uncertainty. We have adopted the 'Confirmation Theory' as used in MYCIN approach (Shortliffe & Buchanan, 1975). This approach works well with rule based representation of domain knowledge.

Shortliffe and Buchanan, 1975 developed the Certainty Factor (CF) model in the mid-1970s for MYCIN, an expert system for the diagnosis and treatment of infections of the blood (Shortliffe & Buchanan, 1975). Since then, the CF model has been widely adopted for uncertainty management in many rule based systems. Each rule is assigned CF by domain experts. Higher CF indicates that the conclusion can be asserted with higher confidence when the conditions are true. CF denotes change in belief in a hypothesis given some evidence. A value of +1.0 indicates absolute belief and -1.0 indicates absolute disbelief. The method generally used to propagate the measure of uncertainty in the antecedents and the uncertainty attached to the rule to the conclusions being derived is briefly explained below. This propagation is done in two steps (Kumar, et al., 2007).

- The different antecedents in the rule, in general, have different values of uncertainty attached to them. As a first step, we aggregate these values into a single CF, using the option considering the strength of the weakest link in a chain as the strength of the chain. This is defined as:

  $CF_{antecedents}$ = {minimum of CFs of all antecedents} (1)

- Then this measure (uncertainty for the set of antecedents) is combined with the measure of uncertainty attached to the rule to give a measure of uncertainty for the conclusion of the rule.

  CF of the conclusion from rule = {CF associated with rule R1} * {$CF_{antecedents}$}, provided $CF_{antecedents}$ >= threshold} (2)

It can be seen that the CF obtained for a conclusion from a particular rule will always be less than or equal to the CF of the rule. This is consistent with the interpretation of the CF used by MYCIN, that is, the CF of a rule is the CF to be associated with the conclusion if all the antecedents are known to be true with full certainty. In a typical rule based system, there may be more than one rule in the rule base that is applicable for deriving a specific conclusion. Some of them will not contribute any belief to the conclusion, because CF of antecedents is less than the threshold. The contributions from all the other rules for the same conclusion have to be combined. For MYCIN model, initially CF of a conclusion is taken to be 0.0 (i.e. there is no evidence in favour or against) and then as different rules for the conclusion fires, the CF gets updated. MYCIN uses a method that incrementally updates the CF of the conclusion as more evidence for and against is obtained. Let CF_{old} be the CF of the conclusion so far, say, after rules R_1, R_2,...R_m have been fired. Let CF_{in} be the CF obtained from firing of another rule Rn. The new CF of the conclusion (from rules R_1, R_2..........R_m and R_n), CFnew, is obtained using the formulae given below.

$$CF_{new} = CF_{old} + CF_{in} * (1 - CF_{old}) \quad \text{when } (CF_{old}, CF_{in} > 0) \qquad (3)$$

$$CF_{new} = CF_{old} + CF_{in} * (1 + CF_{old}) \quad \text{when } (CF_{old}, CF_{in} < 0) \qquad (4)$$

$$CF_{new} = (CF_{old} + CF_{in}) / (1 - \min(|CF_{old}|, |CF_{in}|)) \quad \text{otherwise} \qquad (5)$$

We adopt this calculus in our model and explained later with a running example in section VI. Before that the concept emotion profiling and the compete framework of emotion recognition system has been introduced.

IV. Concept of Emotion Profiling

Emotion profile (EP) is introduced for understanding the variation of each feature for different emotional states. This is the core domain of rule based system to classify the target emotions. We define the emotion profile as the degree by which a given feature could reasonably differentiate among target emotions. If E is denoted as set of emotions and 2E is the set of subsets of emotions, then EP of feature (F_i) is defined as

$$EP(F_i) = \{X_i \mid X_i € 2^E ; i = 1,2,\ldots N\}$$

such that all elements of E occurs once and only once in the emotion profile.

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

There could be two extreme scenarios mentioned below as 'worst scenario' and 'best scenario'.

$$EP(F_i) = \{\{E_1, E_2, E_3, E_4, E_5, E_6 \ldots\ldots\ldots\ldots E_N\}\}$$

represents 'worst scenario' because the feature Fi is not able to differentiate between any of the target emotions. This is normally due to the variation in the feature value being independent of the emotional state, and generally means the feature is not a useful one for this purpose.

$$EP(F_i) = \{\{E_1\}, \{E_2\}, \{E_3\}, \{E_4\}, \{E_5\}, \ldots\ldots\ldots \{E_N\}\}$$

represents 'best scenario' as the feature F_i is strong enough to differentiate between every individual emotions. For example, if feature f_1 (distance between nose and lip) observed to differentiate the emotional states 'disgust' and 'happy' but not able to differentiate between 'fear' and 'sad' and 'anger' from 'neutral' (as their range of values are very close) then we represent emotion profile of the feature f_1 as

$EP(F_1) = \{\{H\}, \{D\}, \{F, S\}, \{A, N\}\}$ where D, H, F, S, A and N stands for 'disgust', 'happy', 'fear', 'sad', 'neutral', respectively.

This is further validated by certain rules (illustrated in section VI). As all the features considered for our problems of emotion recognition are numeric in nature, we considered the average value as the final value to define the range and hence to understand the partition between emotions. This process is very much useful in finding the useful set of features. Relevant set of features acts as an ingredient for emotion classification problem. The next section will illustrate the complete process with a concrete example of emotion recognition using facial expressions.

V. General Framework for Emotion Recognition

The conceptual framework for emotion recognition includes preprocessing, feature extraction, feature analysis, selection of the features, formulation of rules and measuring performance to classify the target emotional states. This will be explained using facial expression as an input in next section.

a) *Preprocessing and Feature Extraction*

The objective of preprocessing is to make the input data in a standard format and suitable for extracting the desired features. Feature extraction involves identifying relevant features and formulating algorithms to extract these features from their respective input data.

b) *Feature Analysis and Emotion Profiling*

Once the basic feature set is ready, the next step is analysis of these features. The question, 'how does each of these features vary with the emotion' needs to be answered here. Each feature has been analyzed carefully by looking its emotion profile respectively. Usually all features don't contribute to the same extent to recognize different emotional states.

c) *Formulation of Rules Using Features*

Influential and useful features can be used to define rules, as follows:

- Emotion profile had been created for each feature to analyze its ability to distinguish among the target emotional states, and accordingly useful features were shortlisted.
- Rules are formed using each of these features for different target emotional states. A feature may yield one or more rules. Generally these rules have the form: if feature F_1 has value less than T_1 and feature F_1 has value greater than T_2 then conclude emotion $= e_1$. For each rule, the cut off points T_1 and T_2 for a given emotion class is taken to be the approximate average of the value of that emotion with its immediate emotion neighbor.
- To each rule, we associate CF values for each emotional class. These values of CFs are decided as per guidelines mentioned in Table 1.

There may be multiple rules associated with each feature. Multiple rules when fired simultaneously (based on values of different features) may saturate the values of CF associated with them. To minimize this possibility, we have chosen relatively lower range of CF values. Given our observation that most features do not provide a high degree of discrimination for any of the target emotion, a high value did not appear justified for any individual feature. The chosen range also allows the CF value to climb steadily to a high range, when there are many features supporting an emotion. The rules may point to a specific emotional state or a set of emotional states. If the distance of an emotion with its neighboring emotion is found to be less than 5% to 6% of the entire spread (overall range i.e. difference between upper value and lower value) for that features value, then these emotions are grouped as a subset. Allocation of these CF value to the target classes is done based on the three interclass rules (IR-1, IR-2 and IR-3). This is derived based on analysis of the emotion profile.

IR-1 (High Interclass Distance):

If the interclass distance of an emotional class (either singleton or non-singleton) with its neighbors (left side as well as right side) is more than 15% of the entire spread for that feature, then the chances of a confusion with the neighboring class is low and hence the CF value associated with this class for that feature is considered to be 0.3.

IR-2 (Medium Interclass Distance):

If the interclass distance of a emotional class (either singleton or non-singleton) with its neighbors (left side as well as right side) is in between 6% to 15% of the

© 2014 Global Journals Inc. (US)

entire spread for that feature, then the CF value associated with this class is considered to be 0.2.

IR-3 (Low Interclass Distance):

If the interclass distance of a emotional class (either singleton or non-singleton) with its neighbors (left side as well as right side) is less than 6% of the entire spread for that feature, then the CF value associated with this class is considered to be 0.1.

d) Recognizing Emotions a using Rules

Overall system's performance for recognizing emotions was measured with the final value of CF corresponding to all the emotional states for all images in the test set. The highest value of final CF is considered.

VI. Case Study for Facial Expression

The standard database, Cohn-Kanade (CK) (Kanade, et al., 2000) of the static images have been used, where individuals are constrained to look straight at the camera and they are photographed with single colored background and illumination conditions do not vary drastically. Therefore, preprocessing issues are not a concern here. Total of 184 images from 57 subjects (32 female and 25 male subjects) have been selected for the emotional states of neutral, anger, happy, fear, sad, and disgust.

Table 1: Defining Certainty Factor (CF) for Rules

Range of the CF	CF Values	Belief and Disbelief	Indicated by
Greater than 0.2 and up to 0.4	0.3	High evidence	High Inter class distance
Greater than 0.1 and up to 0.2	0.2	Moderate evidence	Medium Inter class distance
Equal to 0.1	0.1	Low evidence	Low Inter class distance

a) Feature Extraction

The frontal view face model (Pantic & Rothkrantz, 2000b) is composed of many elements like mouth, nose, eyes and brows (Figure 1 and Table 2). By using a set of 18 points in the frontal view image, total of 21 features (f_3, f_4, f_5, f_6, f_7, f_8, f_9, f_{10}, f_{11}, f_{12}, f_{13}, f_{14}, f_{15}, f_{16}, f_{17}, f_{19}, f_{20}, f_{21}, f_{22}, f_{23}, f_{24} as shown in Figure 1, mostly in the form of inter-point distances had been extracted. For example, the feature f_3 is the distance between left eye outer corner, A to left eyebrow outer corner, E. Similarly feature f_4 (symmetrical to f_3) is the distance between right eye outer corners, A_1 to right eyebrow outer corner, E_1. Each of these points has been extracted from the image. The distances are compiled and are used for further analysis. All these distances were obtained for different emotions including the neutral state for all subjects. Facial expressions are often characterized by variation of a feature from its value in the neutral state, rather than its absolute value in a given state.

Therefore, standardization of these features w.r.t their neutral value was done. These parameters were normalized in the following manner:

Normalized Value = (Measured Value – Neutral State Value) / Neutral State Value (6)

Hence forth, in the remaining paper the reference made to use these normalized values as feature value as an input variable.

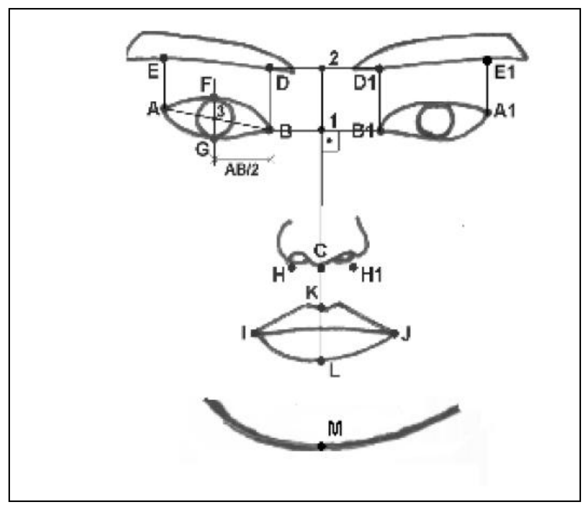


Figure 1 : Facial points (Pantic & Rothkrantz, 2000b)

b) Feature Analysis and Emotion Profiling

As discussed earlier all features might not be useful in forming the rules. Individually each of these has to be analyzed. For example, the feature, lip distance (horizontal distance- f_{16} and vertical distance- f_{17}) could be seen as varying with emotions (Figure 2 and Figure 3).

The emotion profile of these feature (i.e. f_{16} and f_{17}) are represented as

$$EP(f_{16}) = \{\{A, D\}, \{N\}, \{S\}, \{F\}, \{H\}\}$$

$$EP(f_{17}) = \{\{A\}, \{S\}, \{N, D\}, \{F\}, \{H\}\}$$

The lip movement (horizontal lip distance, f_{16} and vertical lip distance, f_{17}) provides good separation between 'happy', 'sad', 'fear' w.r.t 'neutral' state (as per table-1).The emotions 'anger' and 'disgust' appear to be very close with each other for f_{16}. But the feature f_{17} is able to discriminate 'anger', 'sad', 'fear' and 'happy' but 'disgust' if found to be in the vicinity of 'neutral'. This

© 2014 Global Journals Inc. (US)

exercise is done for al features. Few observations are as follows:

Symmetrical pairs of features (like left eye vertical distance, f_9 and right eye vertical distance, f_{10}) do not always have the same emotion profile. For example, f_9 clearly differentiates between 'disgust' and 'fear', but doesn't show a reasonable separation between other pairs of emotions e.g. {'anger', 'happy'} and {'neutral', 'fear'}.

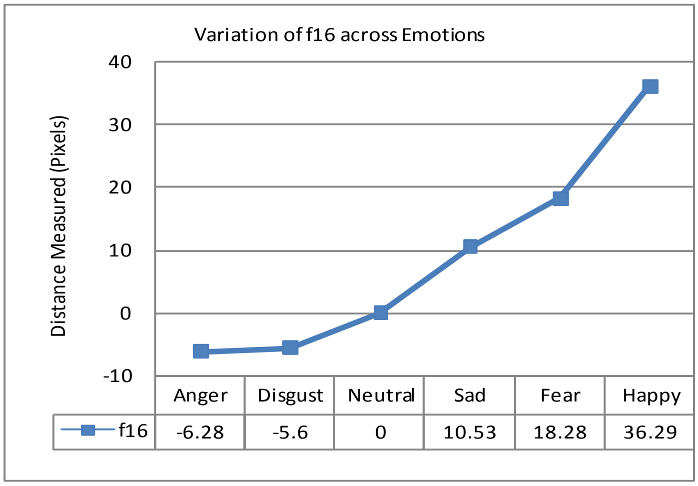


Figure 2 : Variation of feature f_{16} across emotions

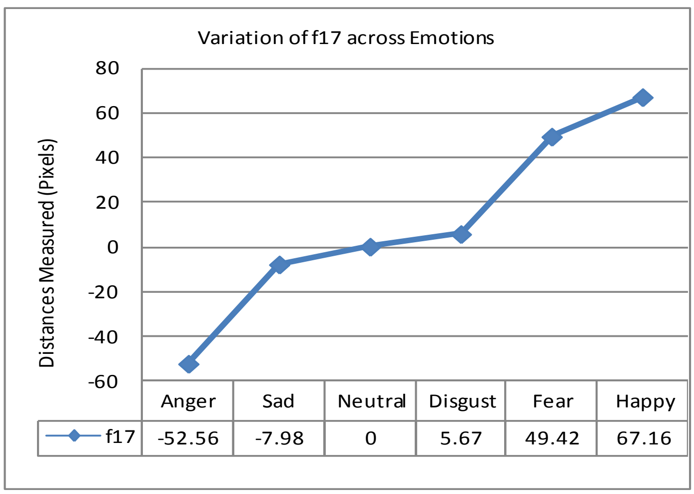


Figure 3 : Variation of feature f_{17} across emotions

The feature f_{10} differentiates reasonably well between all the target emotions. The same is true with f_{12} feature (distance between left lip and left eye). But f_{13} feature (distance between right lip and right eye) differentiate a cluster of emotion {'happy',' disgust'} and {'sad', 'fear'}.

The symmetrical features, f_{12} and f_{13} show the same results for 'neutral' and 'anger' only. It is observed that total of eleven features (i.e. f_3, f_4, f_9, f_{10}, f_{11}, f_{12}, f_{13}, f_{14}, f_{15}, f_{16}, and f_{17}) shows significant variation across the target emotional states among all twenty one features. Hence these 11 features will be most relevant and useful in designing rules further for recognizing emotions.

TABLE 2: Features of the facial points (Pantic & Rothkrantz, 2000b)

Features	Feature Description
f_3	Distance AE
f_4	Distance A_1E_1
f_5	Distance 3F, 3 is the centre of AB (See Figure 1)
f_6	Distance $4F_1$, 4 is the centre of A_1B_1 (See Figure 1)

© 2014 Global Journals Inc. (US)

f_7	Distance 3G
f_8	Distance $4G_1$
f_9	Distance FG
f_{10}	Distance F_1G_1
f_{11}	Distance CK, C is $0.5HH_1$
f_{12}	Distance IB
f_{13}	Distance JB_1
f_{14}	Distance CI
f_{15}	Distance CJ
f_{16}	Distance IJ
f_{17}	Distance KL
f_{19}	Image intensity in circle (r($0.5BB_1$), C(2)) above line (D, D_1)
f_{20}	Image intensity in circle (r($0.5BB_1$), C(2)) below line (D, D_1)
f_{21}	Image intensity in circle (r(0.5AB), C(A)) left from line (A, E)
f_{22}	Image intensity in circle (r($0.5A_1B_1$), C(A_1)) right from line (A_1, E_1)
f_{23}	Image intensity in the left half of the circle (r($0.5BB_1$), C(I))
f_{24}	Image intensity in the right half of the circle (r($0.5BB_1$), C(J))
Total	21 Features

c) Formulation of Rules

From the trend of feature f_{16} (Figure 2), it is seen that the emotions 'neutral', 'sad', 'fear' and 'happy' are distinguishable individually, whereas the emotions, 'disgust' and 'anger' are found to be close together (as the distances with its neighbour are found to be in the range of 5% to 6% of the entire spread). Depending on the interclass distances of these classes CFs has been allocated (as per Table 1) and rules have been formed. For each rule (of the type if – then), the cutoff point (i.e., upper limit, T2 and lower limit, T1) belonging to the emotion class is taken to be the average of the value of that class with its immediate emotional class. From the figure 2, it is clear that for 'sad' emotion the cutoff points (i.e. T1 and T2) to be considered are 5 and 14, forming the singleton class and due to high inter class distances the CF values is to be considered as 0.3 (see Table 1). Similarly, the feature f17 also varies across emotions (Figure 3). It is observed that 'neutral' along with 'disgust' is forming a non-singleton class while rest of the emotions is acting as singleton classes. It is observed that for 'sad' emotion the cutoff points (i.e. T_1 and T_2) to be considered are -30 and -3.

Depending on distances between these classes, CFs has been allocated and rules have been formed. We found a total of five conditions each for the feature f_{16} and feature f_{17} to classify emotions. Examples of rules (Rule 1 and Rule 2) are shown below.

Example Rule 1: Using dist_horizontal_lip (f_{16}) for emotion identification

(i) if (dist_horizontal_lip <= -3)
$CF_{Dis}=0.2$; $CF_{Ang}=0.2$;

(ii) if ((dist_horizontal_lip > -3) && (dist_horizontal_lip <= 5))
$CF_{Neu}=0.3$;

(iii) if ((dist_horizontal_lip > 5) && (dist_horizontal_lip <= 14))
$CF_{Sad}=0.3$;

(iv) if ((dist_horizontal_lip > 14) && (dist_horizontal_lip <= 27))
$CF_{Fear}=0.3$;

(v) if (dist_horizontal_lip > 27)
$CF_{Hap}=0.3$;

Example Rule 2: Using dist_vertical_lip (f_{17}) for emotion identification

(i) if (dist_vertical_lip < -30)
CFAng=0.3;

(ii) if ((dist_vertical_lip < -3) && (dist_vertical_lip >= -30)) CFSad=0.2;

(iii) if ((dist_vertical_lip < 27) && (dist_vertical_lip > -3)) CFNeu=0.3; CFDis=0.3;

(iv) if ((dist_vertical_lip >= 27) && (dist_vertical_lip < 58)) CFFear=0.3;

(v) if (dist_vertical_lip >= 58)
CFHap=0.3;

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

TABLE 3: Examples of computed values of CF using rules from face for female subject							
Updated Value of CF computed using rules for respective emotion							
Subject	Actual Emotion	CF_{Sad}	$CF_{Neutral}$	CF_{Angry}	CF_{Happy}	CF_{Fear}	$CF_{Disgust}$
s_1	S	0.83	0.56	0.30	0.36	0.72	0.00
s_1	N	0.00	0.97	0.00	0.00	0.30	0.00
s_1	A	0.10	0.37	0.91	0.20	0.50	0.51
s_1	H	0.30	0.30	0.30	0.82	0.36	0.30
s_1	F	0.78	0.37	0.00	0.20	0.84	0.00
s_1	D	0.00	0.00	0.85	0.51	0.20	0.87

Such kind of exercise is done for each of the selected features. Symmetrical pair of features like (f_3, f_4), (f_9, f_{10}), (f_{12}, f_{13}) and (f_{14} and f_{15}) do not vary in the same way across different emotions and hence the resulting rules may differ. Total of 11 rules have been formed for emotion identification using facial static images.

d) Recognizing Emotions using Rules

All these rules have been tested on the database and final value of CF has been computed corresponding to each of the 6 emotional states. The emotion with the highest value of final CF is considered and counted against the expected emotion class for each image for all the subjects. For example, Table 3 shows the computed values of CF corresponding to all the six emotions - sad (S), neutral (N), anger (A), happy (H), fear (F) and disgust (D).

A row in this table indicates an input image of an individual subject (s_1) in a particular emotional state. Final outcome for the same is indicated in these CF values under the six columns labelled from CF_{Sad} to $CF_{Disgust}$. For example, row 3 corresponds to subject-1 (i.e. s_1) in 'angry' state; the table shows the maximum value of CF under the emotion class of 'anger' (i.e. 0.91) showing correct identification. Similarly, the maximum value of CF for the subject-1 (i.e. s_1; row 6) is 0.87 and is for the target emotion of disgust. Though the value belonging to 'anger' is coming close to this value, we are considering the highest value of CF to identify the target emotion associated with the input image. Hence, the computed emotion matches with the 'predicted emotion' which is 'disgust' in this case and 'anger' in the previous case. Similarly computed value of CF has been analyzed for each of the emotions. Table 4 shows the overall recognition results for each emotion class using confusion matrices.

The literature discusses results for various face based emotion classification systems (Azcarate et al., 2005; Zhao & Keearney, 1996; Fasel & Luettin, 2003; Pantic & Rothkrantz, 2000a; Sebe et al., 2007; Pantic & Rothkrantz, 2000b, Kobayashi & Hara, 1992; Edwards et al., 1998; Lyons et al., 1999; Huang & Huang, 1997; Hong et al., 1998 and Kulkarni et al., 2009). The average expression recognition rate of all of these systems is around 82% (in the range of 64% to 100%). Some of these studies have used limited testing data for training and for testing.

In comparison, the overall correctness of recognizing emotions using our rule based approach from facial expression is found to be 86.43%. The recognition rates are found to be 80% and 88.89% for female and male subjects respectively. Recognition rate of 'anger' and 'fear' is high for male subjects as compared to female subjects. For example, it is observed that rate of recognition for 'anger' is coming out to be 100% for male and 69% for female.

This rule based approach could be extended to any other modalities easily as it is based on the set of rules which could be extracted from different modalities (e.g. facial expression, speech or others). The overall process remains same i.e. to design the rules all the relevant features needs to be studied in more detail in the similar fashion. Emotion Profiling of each feature acts as an important ingredient as it is useful to map the relevant feature set for target emotional states. Influential and useful features were selected for defining the rules. Performance of the system could be improved by modifying, adding and deleting rules.

© 2014 Global Journals Inc. (US)

TABLE 4: Confusion Matrices for Gender Independent Case

	S	N	A	H	F	D
Sad (S)	8	1	1	0	2	1
Neutral (N)	0	57	0	0	0	0
Anger (A)	1	1	20	0	0	3
Happy (H)	0	1	1	36	2	2
Fear (F)	1	0	0	1	10	0
Disgust (D)	0	2	2	2	1	28

VII. Conclusion and Future Work

Emotion is assuming increasing importance in HCI, in general, with the growing feeling that emotion is central to human communication and intelligence. While various aspects of this problem have been addressed in the literature, the full problem has not received much attention so far. The primary concern in emotion recognition is inaccurate knowledge and data. There are hardly any features or feature combinations which can infer any emotion to complete the certainty. In general, there are no features that are universally effective for recognizing all emotions. There are some features which provide reasonable discrimination among various subsets of emotions. Hence the concept of 'emotion profile' is useful for extensive analysis and evaluation of individual features. We used the confirmation theory as used in MYCIN system where the values of CF are allocated to the emotional classes based on interclass distances. These have been derived based on the analysis of the emotion profile of individual features. Rule based systems have certain advantages. Because of the uniform syntax, each rule can be easily analyzed. The syntax is usually quite simple, so it is easy to understand the rules without an explicit translation. Rules could be considered as independent pieces of knowledge about the domain and this independence leads to a high degree of modularity. Performance of the system could be improved by modifying / adding / deleting rules. This rule based system is applicable for any modalities like speech, gesture, facial expressions, etc. if provided with set of features. To validate further a study was done on speech and keyboard usage modality using the above mention rule based system.

Given the vast scope of the work needed to build reliable emotion recognition system and use the same for enhancing the HCI, and the unavailability and difficulty in collecting reliable datasets for emotion recognition, this work covers only a part of the journey. A number of aspects require further investigation and refinement. To mention a few limitations against the use of certainty factor is that they have no sound theoretical basis; though, they often work well in practice. We allocated the values of CF to the emotional classes based on heuristic rules as defined in section III. These have been derived based on the analysis of the individual features across different emotions. In this work, we have ignored the possibility of having more than one emotional state at a time. Also the investigation to alternative uncertainty models like the Dempster-Shafer Theory is still open. Demspter Shafer theory provides more flexibility in assigning belief to various subsets of emotions. The databases used for the expression analysis are all based on subjects who "performed" a series of different expressions. There is a significant difference between expressions of a spontaneous and of a deliberate nature. Without a database of spontaneous expressions, the expression analysis system cannot be robust enough. This database issue is common for all the modalities – may be speech, facial expressions, etc. The multimodal data fusion for emotion recognition remains an open challenge as several problems still persist, related to finding optimal features, integration and recognition. Completely automated multimodal emotion recognition system is still at the preliminary phase, shows very limited performance and is mostly restricted to the lab environment.

References Références Referencias

1. Marinez-Miranda, J. & Aldea, A. (2005). Emotions in Human and Artificial Intelligence, in Computers in Human Behaviour Journal, R. D. Tennyson (Ed.). 21(2), 323-341.
2. Foley, J.D. (1996). JTEC Panel Report on Human Computer Interaction Technologies in Japan, March 1996, Retrieved from http://www.wtec.or/pdf/hci.pdf / on January, 2013.
3. Lisetti, C.L.& Nasoz, F. (2005). Affective intelligent car interfaces with emotion recognition HCI 2005, 11th International Conference on Human Computer Interaction , July 22-27, Las Vegas, USA.
4. Bower, G. (1981). Mood and Memory, American Psychologist 36 (2), 129–148.
5. Zajonc, R. (1984). On the Primacy of Affect, American Psychologist 39, 117–124.
6. Damasio, A. (1994). Descartes' Error, Avon Books, New York, NY.
7. Ledoux, J. (1992). Brain Mechanisms of Emotion and Emotional Learning, Current Opinion in Neurobiology, 2, 191–197.
8. Derryberry, D. & Tucker, D. (1992). Neural Mechanisms of Emotion, Journal of Consulting and Clinical Psychology 60 (3), 329–337.

Global Journal of Computer Science and Technology (F) Volume XIV Issue III Version I Year 2014

© 2014 Global Journals Inc. (US)

9. Colquitt, J.A., LePine, J.A. & Noe, R.A. (2000). Toward an integrative theory of training motivation: a meta-analytic path analysis of 20 years of research, Journal of Applied Psychology 85, 678–707.
10. Frijda, N.H. (1986). The Emotions, Cambridge University Press, New York.
11. Birdwhistle, R.L. (1970). Kinesics and Context: Essays on Body Motion and Communication, University of Pennsylvania Press.
12. Ekman, P. & Friesen, W.V. (1975). Unmasking the Face: A Guide to Recognizing Emotions from Facial Expressions, Prentice Hall, Inc, New Jersey.
13. Chovil, N. (1991). Discourse-Oriented Facial Displays in Conversation, Research on Language and Social Interaction, 25, 163-194.
14. Goleman, D. (1995). Emotional Intelligence, Bantam Books, New York.
15. James, L. & Nahl, D. (2000). Road Rage and Aggressive Driving: Steering Clear of highway Warfare, Prometheus Books, Amherst, NY.
16. Khanna, P. & Kumar, S. (2010). Recognizing Emotions from Human Speech, Think Quest, International Conference on Contours of Computing Technology in association with Springer Publications, Mumbai India.
17. Khanna, P. and Kumar, S. (2011). Application of Vector Quantization in Emotion Recognition from Human Speech, Springe Series in Communications in Computer and Information Science (CCIS), ICISTM, 118-125.
18. Khanna, P. & Kumar, S. (2010). Recognizing Emotions from Keyboard Stroke Pattern, International Journal of Computer Applications,11(9).
19. Picard, R.W. (1997). Affective computing, The MIT Press, Cambridge, MA.
20. De Silva & Ng (2000). Bimodal Emotion Recognition, Automatic Face and Gesture Recognition, in IEEE International Conference, 332 – 335.
21. Sebe, N., Cohen, I., Gevers, T., & Huang, T.S. (2006). Emotion Recognition Based, On Joint Visual and Audio Cues", Pattern Recognition, International Conference on, 1, 1136–1139.
22. Zeng, Z., Jilin, Tu., Liu, Huang, Pianfetti, Roth & Levinson. (2007). Audio-Visual Affect Recognition, IEEE Transactions on multimedia, 9 (2), 424-428.
23. Kim, J., & André, E. (2006). Emotion recognition using physiological and speech signal in short-term observation, Perception and Interactive Technologies: LNAI 4201, 53-64. Springer-Verlag Berlin Heidelberg.
24. Corradini, A., Mehta, M., Bernsen, N. & Martin, J.C. (2003). Multimodal input fusion In Human computer interaction on the example of the on-going nice project, In Proceedings of the NATO-ASI conference on Data Fusion for Situation Monitoring, Incident Detection, Alert and Response Management, Yerevan (Armenia).
25. Liao, H. (2002). Multimodal Fusion, Master's thesis, University of Cambridge.
26. Kettebekov, S. & Sharma, R. (2000). Understanding Gestures in Multimodal Human Computer Interaction, International Journal on Artificial Intelligence Tools, 9(2), 205-223.
27. Sharma, R., Pavlovic, V., & Huang, T. (1998). Toward Multimodal Human Computer Interface, in Proceedings of the IEEE, 86(5), 853-860.
28. Kumar, S., Ramani, S., Raman, S.M., Anjaneyulu K.S.R. and Chandrasekar, R. (2007). Rule Based Expert Systems – A Practical Introduction, Narosa Publishers.
29. Shortliffe, E.H. & Buchanan, B.G. (1975). A Model of Inexact Reasoning in Medicine, Mathematical Biosciences, 23, 351-379.
30. Gordon, J. & Shortliffe, E.H. (1984). The Dempster-Shafer Theory of Evidence, 272-292 in text reference: (Buchanan and Shortliffe, 1984).
31. Negoita, C.V. (1985). Expert Systems and Fuzzy Systems, Benjamin/Cummings.
32. Doyle, J.A. (1979). Truth Maintenance System, Artificial Intelligence, 12, 231-272.
33. Reiter, R. (1980). A Logic for Default Reasoning, Artificial Intelligence, 13, 81-132.
34. McDermott, D. & Doyle, J. (1980). Non-monotonic Logic I, Artificial Intelligence, 13, 41-72.
35. Kanade, T., Cohn, J. & Tian, Y. (2000). Comprehensive Database for Facial Expression Analysis, in Proceedings of the International Conference on Automatic Face and Gesture Recognition, 46-53.
36. Azcarate, A., Hageloh, F., van de Sande, K. & Valenti, R. (2005). Automatic facial Emotion recognition,University of Amsterdam Technical Report.
37. Zhao, J. & Keearney, G. (1996). Classifying Facial Emotions by Back propagation Neural Networks with Fuzzy Inputs, Proceedings of Conference on Neural Information Processing, 454-457.
38. Fasel, B. & Luettin, J. (2003). Automatic Facial Analysis A Survey, Pattern Recognition, 36, 259-275.
39. Pantic, M. & Rothkrantz, L.(2000a). Automatic Analysis of Facial Expressions: The State of the Art, IEEE Transaction on Pattern Analysis and Machine Intelligence", 22, 1424-1445.
40. Sebe, N., Lew, M.S., Sun, Y., Cohen, L. Gevers, T., & Huang, T.S. (2007). Authentic Facial Expression Analysis, Image and Vision Computing, 25, 1856-1863.
41. Pantic, M. & Rothkrantz, L.J.M. (2000b). Expert System for Automatic Analysis of Facial Expression, Journal of Image and Vision Computing 18, 881-905.

© 2014 Global Journals Inc. (US)

42. Kobayashi, H. & Hara, F. (1992). Recognition of Six Basic Facial Expressions and Their Strength by Neural Network, Proceedings of International Workshop Robot and Human Communication, 381-386.
43. Edwards, G.J., Cootes, T.F. & Taylor, C.J. (1998). Face Recognition Using Active Appearance Models, Proceedings of European Conference on Computer Vision, 2, 581-695.
44. Lyons, M.J., Budynek, J. & Akamatsu, S. (1999). Automatic Classification of Single Facial Images, IEEE Transactions on Pattern Analysis and Machine Intelligence, 21, 357-362.
45. Huang, C.L. & Huang, Y.M. (1997). Facial Expression Recognition Using Model Based Feature Extraction and Action Parameters Classification, Journal of Visual Communication and Image Representation 8, 278-290.
46. Hong, H., Neven, H. & Malsburg, C von der. (1998). Online Facial Expression Recognition Based on Personalized Galleries, Proceedings of International Conference on Automatic Face and Gesture Recognition, 354-359.
47. Kulkarni, S.S., Reddy, N.P. & Hariharan, S.I. (2009). Facial expression (mood) recognition from facial images using committee neural networks, Bio Medical Engineering.

© 2014 Global Journals Inc. (US)

This page is intentionally left blank

© 2014 Global Journals Inc. (US)

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 14 Issue 3 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Robust Image Retrieval using Dominant Colour with Binarized Pattern Feature Extraction and Fast Correlation

By Gayatri Tiwari, Prof. Dr. Bhupesh Gour & Prof . Dr. Asif Ullah Khan
Technocrats Institute of Technology Bhopal, India

Abstract- The modern technology providing the sharing of information at very fast rate such as audio, video and images. The sharing of such data also increased as the social networking sites become popular among young generation. Now the online databases of images is so huge having millions of images, and the searching of images we need is crucial task. For such applications various image retrieval methodologies is proposed. In this paper we are proposing very efficient image retrieval technique based on dominant colour features extraction and pattern feature extraction. In the simulation results we have found that from around 6000 images proposed algorithm takes only 1.5 seconds to retrieve results. That is why this approach is significant in terms of retrieval speed.

Keywords: image retrieval, colour features, binarized pattern features, retrieval speed and correlation.
GJCST-F Classification : I.4.0

ROBUSTMAGERETRIEVALUSINGDOMINANTCOLOURWITHBINARIZEDPATTERNFEATUREEXTRACTIONANDFASTCORRELATION

Strictly as per the compliance and regulations of:

© 2014. Gayatri Tiwari, Prof. Dr. Bhupesh Gour & Prof . Dr. Asif Ullah Khan. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction inany medium, provided the original work is properly cited.

Robust Image Retrieval using Dominant Colour with Binarized Pattern Feature Extraction and Fast Correlation

Gayatri Tiwari [α], Prof. Dr. Bhupesh Gour [σ] & Prof. Dr. Asif Ullah Khan [ρ]

Abstract- The modern technology providing the sharing of information at very fast rate such as audio, video and images. The sharing of such data also increased as the social networking sites become popular among young generation. Now the online databases of images is so huge having millions of images, and the searching of images we need is crucial task. For such applications various image retrieval methodologies is proposed. In this paper we are proposing very efficient image retrieval technique based on dominant colour features extraction and pattern feature extraction. In the simulation results we have found that from around 6000 images proposed algorithm takes only 1.5 seconds to retrieve results. That is why this approach is significant in terms of retrieval speed.

Keywords: image retrieval, colour features, binarized pattern features, retrieval speed and correlation.

I. Introduction

Content Based Image Retrieval is a term used to describe the process of retrieving images form a large collection on the basis of features(such as COLOUR, texture etc) that can be automatically extracted form the images themselves [19]. The retrieval thus depends on the contents of images. CBIR is comparatively a new topic and has turn into a hot research subject in last few years. The features that are used in CBIR should correspond directly to general routine notions of the human vision. For example, COLOUR, texture and shape are general terms used by most of people.

These features are mostly used for CBIR. But it is hard to define precisely how these features are discriminated by humans. Also, such discriminations are different for different people. Thus we need to pre-define the suitable feature representation scheme for each of these features. These features can be applicable over complete image or over a small region of the image. It is found that in most image retrieval systems, COLOUR based features play a prominent role. Indeed, COLOUR is the most important factor in human perception. The majority common representation of COLOUR information is in the form of COLOUR histogram, which statically is the probability of any given pixel having a Specific intensity in each of the COLOUR channels. COLOUR anglogram [20], correlogram [18], COLOUR co occurrence matrix (CCM) [22] are some of the other feature representations for COLOUR.

Author α σ ρ: M-Tech Research Scholar, Research Guide, Department of Computer Science Engineering Technocrats Institute of Technology (excellence), Bhopal. e-mails: gayatritiwari.be2012@gmail.com, bhupesh_gour@rediffmail.com, asifullahkhan@rediffmail.com

II. System Model

In content-based image retrieval (CBIR) image databases are indexed with descriptors derived from the visual content of the images. Most CBIR systems are worried with estimated queries where the aim is to find pictures visually similar to a particular target picture. In most cases the goal of CBIR systems is to replicate human perception of image similarity as well as possible. CBIR presents a challenging problem since it has common elements with both the general image understanding problem (which seems to remain unsolvable for computers at least in the near future) and the field of general information retrieval. Humans excel in image understanding when compared with computers. In contrast, in systematic handling of large databases computers have an edge over us. For this reason CBIR is also potentially very rewarding.

Global histogram gives information about the COLOUR contents of image and not the spatial distribution of COLOUR in image. Thus COLOUR feature alone cannot give satisfactory results. Texture can give additional information about the spatial arrangements and patterns of varying intensity available image. Texture is an important element to human vision. Texture has been found to provide cause to scene depth and surface orientation. People also tend to relate texture elements of varying size to a 3-D surface. Even in graphic systems greater realism is achieved when textures are mapped to 3-D surfaces. Gabor filters, Tamura filters, Gray level co occurrence matrix (GLCM) etc are used for the texture representation. Discrete Wavelet Transform (DWT) is found to be an effective tool for signal analysis. Wavelets have properties that are suitable for representation of an image texture. Daubechies wavelets and Haar wavelets are some of the examples of texture representation [19]. Shape information is considered to be one of the most difficult features to extract reliably from images since there are no mathematical definitions of shape similarity which

© 2014 Global Journals Inc. (US)

can take into account the various qualities which human assign to shape. While using shape, it is important that the representation should be invariant to basic transformations such as rotation, scale etc. some of the features that are used to represent shape are moment invariants, circularity, area, minimum and maximum axis.

These features of the database images are calculated offline and stored into database. User gives one image as the query image (which may be uploaded or selected from the previous results). Then a system calculates corresponding features for the query image. Similarity measure takes these feature values and those from database and calculate the similarity among query image and each of the database images.

Database images finally are ranked and displayed according to similarity measure.

In general, CBIR can be described in terms of following stages:

a) Identification and utilization of intuitive visual features.
b) Features representation
c) Automatic extraction of features.
d) Efficient indexing over these features.
e) Online extraction of these features from query image.
f) Distance measure calculation to rank images.

III. Proposed Methodology

The image retrieval system proposed in this paper is described below with the block diagram and flow charts. In Fig. 3.1 block diagram of feature database preparation is described. in Fig. 3.2 block diagram of image retrieval is proposed. In Fig. 3.3 flow chart of feature database preparation algorithm is explained. In Fig. 3.4 flow chart of image retrieval algorithm is explained.

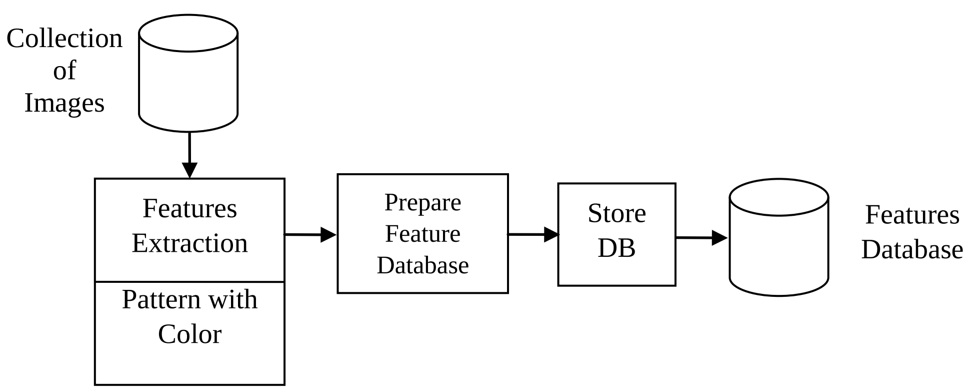


Figure 3.1 : Block Diagram of Feature Database is preparation

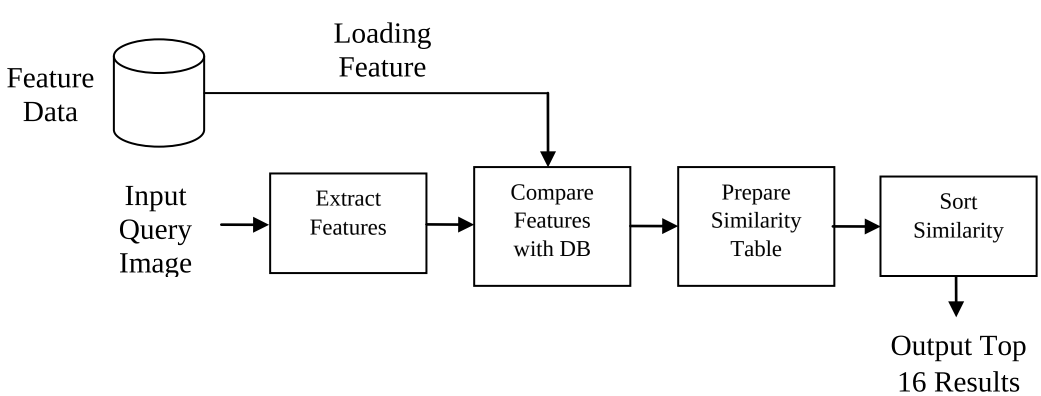


Figure 3.2 : Block Diagram of Image Retrieval

In the block diagrams the proposed methodology is described in first figure the Feature Database is prepared by using the collection of images, features extraction and pattern with color so the preparation of database has been done and then after store in Database.

In this figure the Image Retrieval process is described by using the Feature, Extract the Features from image and compare with Feature Data Base then prepare the similarity table at the end 16 Similar results have been carried out.

© 2014 Global Journals Inc. (US)

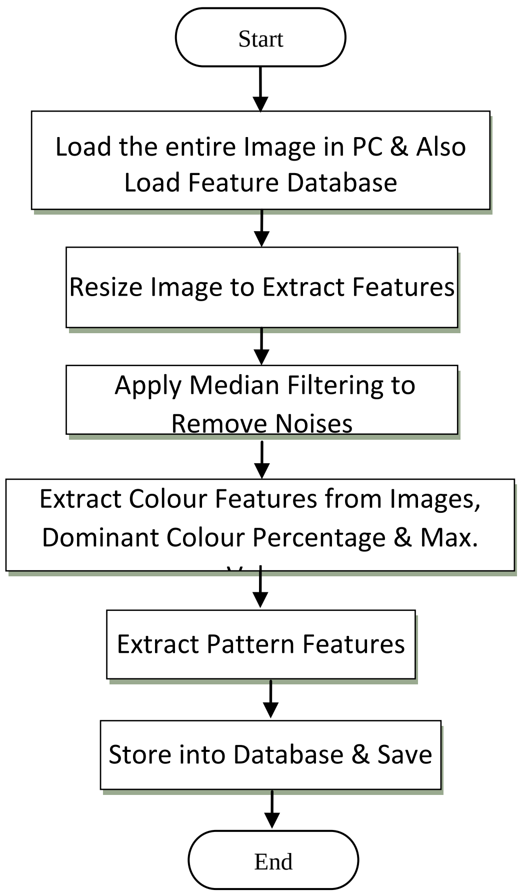


Figure 3.3 : Flow char of feature database preparation

a) Preparing Features Database

In the first flow graph preparing the features database process is achieved in which all images is loaded in PC and also feature database is loaded then resizing to extract feature is done then after Median Filter is adopted for removing the noise then extraction of colour feature from images is done then find out the dominant colour percentage and maximum value is achieved then extraction of pattern feature and store into database.

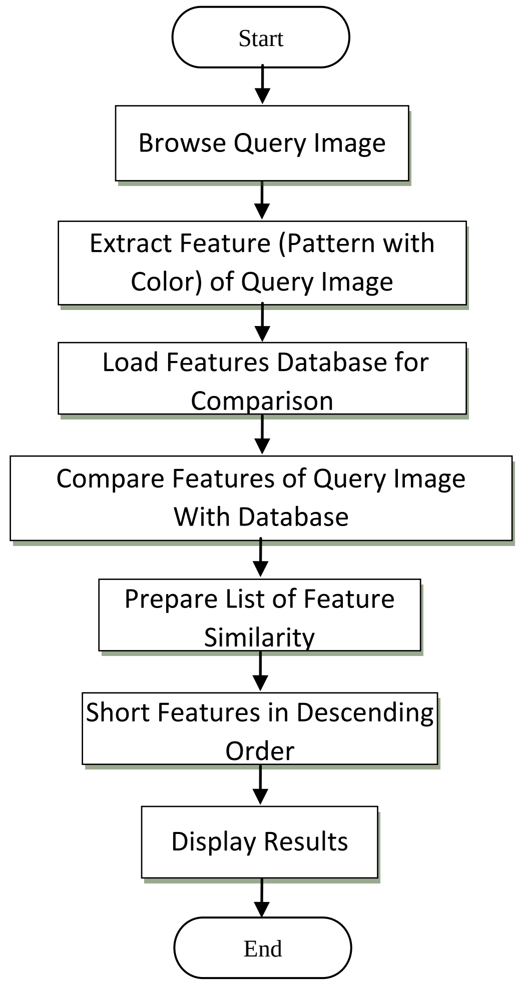


Figure 3.4 : Flow char of image retrieval

b) Image Retrievals

In this flow graph the image retrieval process is achieved. First of all browsing the Query Image then extract feature (Pattern with Color) of Query Image then Loading of Features Database for Comparison purpose then Comparing Features of Query Image after that list is prepared for Feature Similarity then short features in descending order and finally the results have been displayed.

IV. Simulation Results

Image retrieval proposed methodology is implemented on simulation tool and various results are found. The main reason is to develop advanced technique is to get the images from the huge collection faster than every other technique with meaningful results. In this section simulation results of proposed method is shown with different color and shapes.

© 2014 Global Journals Inc. (US)

Figure 4.1 : Retrieval Results of Red Colour and time taken is 1.8268 seconds

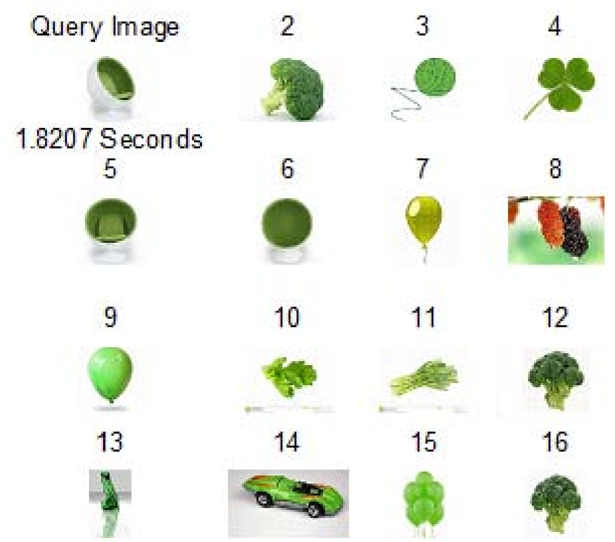


Figure 4.2 : Retrieval Results of Green Colour and time taken is 1.8207 seconds

In Fig. 4.1 proposed algorithm trying to retrieve images of red colour looking similar to girl and the similar results are displayed in the figure. In the retrieved results algorithm first trying to find out the similar images in descending order that is most similar images appear first in the results. The time taken to get the results is 1.8268 seconds.

In Fig. 4.2 proposed algorithm trying to retrieve images of green colour looking similar to cup and the similar results are displayed in the figure. In the retrieved results algorithm first trying to find out the similar images from images collection and arrange in descending order i.e. most similar images appear first in the results. The time taken to get the results is 1.8207 seconds.

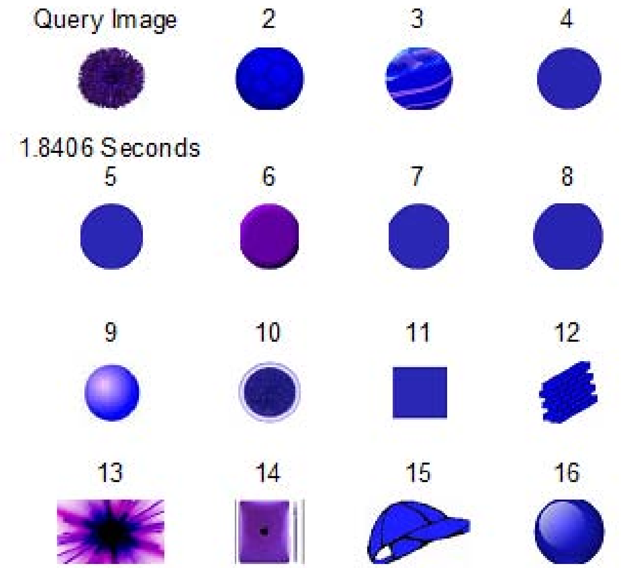


Figure 4.3 : Retrieval Results of Green Colour and time taken is 1.8406 seconds

In Fig. 4.3 proposed algorithm trying to retrieve images of blue/purple colour looking similar to circle or sphere and the similar results are displayed in the figure. In the retrieved results algorithm first trying to find out the similar images from images collection and arrange in descending order i.e. most similar images appear first in the results. The time taken to get the results is 1.8406 seconds.

As we were tried for other shapes and colours the results algorithm takes on an average 1.8 seconds to retrieve each images for each query.

V. Conclusion and Future Scope

Image retrieval is growing and in demand technique used in wide area of application like search engines, social networking sites, surveillance systems etc. The need of image searching is either colour based or patterns. In the proposed methodology of this paper we have adopted method for colour based retrieval as well as pattern based retrieval and we have tried to make is faster like 1.8 seconds to get results.

In the upcoming time hybrid form of multiple techniques definitely improve the accuracy as well as retrieval time.

References Références Referencias

1. H. Tamura, and N. Yokoya, "Image Database Systems: A Survey," Pattern Recognition, vol. 17, no 1, pp.29–49, Sep. 1984.
2. S. Gerard, C. Buckely, "Term-Weighting Approaches in Automatic Text Retrieval," Information Processing and Management, vol. 24, no.5, pp. 513-523, Jan. 1988.

© 2014 Global Journals Inc. (US)

3. Y. Chen, J. Wang, "Image Categorization by Learning and Reasoning with Regions," Journal of Machine Learning Research, vol. 5, pp. 913–939, May 2004.
4. F. Long, H. Zhang, H. Dagan, and D. Feng, "Fundamentals of content based image retrieval," in D. Feng, W. Siu, H. Zhang (Eds.): "Multimedia Information Retrieval and Management. Technological Fundamentals and Applications," Multimedia Signal Processing Book, Chapter 1, Springer-Verlag, Berlin Heidelberg New York, 2003, pp.1-26.
5. Gudivada and V. Raghavan, "Content-based image retrieval systems," IEEE Computer, vol. 28, no 9, pp18-22, Sep. 1995.
6. M. Kherfi, D. Ziou, and A. Bernardi, " Image Retrieval From the World Wide Web: Issues, Techniques, and Systems," ACM Computing Surveys, vol. 36, no. 1, pp. 35–67, March 2004.
7. M. Flickner, H. Sawhney, W. Niblack, J. Ashley, Q. Huang, B. Dom, M. Gorkani, J. Hafner, D. Lee, D. Petkovic, and P. Yanker, "Query by image and video content: The QBIC system," IEEE Computer, vol. 28, no 9, pp.23-32, Sep. 1995.
8. A. Pentland, R. Picard, and S. Sclaroff , "Photobook: Content based manipulation of image databases," International Journal of Computer Vision, vol.18, no 3, pp.233–254, June 1997.
9. J. Smith and S. Chang, "Visualseek: A Fully Automated Content-Based Image Query System," Proceedings of the 4th ACM international conference on Multimedia table of contents, Boston, Massachusetts, United States, Nov. 1996, pp. 87-98.
10. A. Gupta, and R. Jain, "Visual information retrieval," Comm. Assoc. Comp. Mach., vol. 40, no. 5, pp. 70–79, May. 1997.
11. J. Li, J. Wang, and G. Wiederhold, "Integrated Region Matching for Image Retrieval," In Proceedings of the 2000 ACM Multimedia Conference, Los Angeles, October 2000, pp. 147-156.
12. Rao, M.B.; Kavitha, C.; Rao, B.P.; Govardhan, A., "A new feature set for content based image retrieval," Information Communication and Embedded Systems (ICICES), 2013 International Conference on , vol., no., pp.84,89, 21-22 Feb. 2013.
13. Lunshao Chai; Zhen Qin; Honggang Zhang; Jun Guo; Shelton, C.R., "Re-ranking using compression-based distance measure for Content-based Commercial Product Image Retrieval," Image Processing (ICIP), 2012 19th IEEE International Conference on , vol., no., pp.1941,1944, Sept. 30 2012-Oct. 3 2012.
14. Haipeng Li; Jianbo Lu; Jiang Yu, "An image retrieval method based on fractal image coding," Systems and Informatics (ICSAI), 2012 International Conference on , vol., no., pp.1866,1869, 19-20 May 2012.
15. Edmundson, D.; Schaefer, G., "Flickr Retriever -- Fast Retrieval of Flickr Photos," Web Intelligence and Intelligent Agent Technology (WI-IAT), 2012 IEEE/WIC/ACM International Conferences on , vol.1, no., pp.639,640, 4-7 Dec. 2012.
16. Abdelrahim, A.S.; Abdelrahman, M.A.; Mahmoud, A.; Farag, A.A., "Image retrieval based on content and image compression," Multimedia Technology (ICMT), 2011 International Conference on , vol., no., pp.6696,6703, 26-28 July 2011.
17. An-Zen Shih, "The application of fractal compression to content-based image retrieval: Comparison of techniques", Multimedia Technology (ICMT), 2010International Conference on , vol., no., pp.3356,6484, 26 Apr 2010.
18. Huang J., Kumar S.R., Mitra M., Zhu W.J., Zabih R., "Image Indexing using Color Correlograms", IEEE Computer Society Conference on Computer Vision and Pattern Recognition, June 1997 pages 762-768.
19. Siddique S., "A Wavelet Based Technique for Analysis and Classification of Texture Images", M.S Thesis, Carleton University, Ottawa, Canada, April 2002. www.sce.carleton.ca/faculty/cuhadar/CBIR/files/ finalreport.doc.
20. Zhao R., Grosky W.I., "Narrowing the Semantic Gap-Improved Text Based Web Document Retrieval Using Visual Feature", IEEE Transactions on Multimedia Vol.4, No.2, June 2002 pages 189-200.

© 2014 Global Journals Inc. (US)

This page is intentionally left blank

© 2014 Global Journals Inc. (US)

Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 14 Issue 3 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Sift Algorithm for Iris Feature Extraction

By Kinjal M. Gandhi & Prof. R. H. Kulkarni
Pune University, India

Abstract- Iris recognition is proving to be one of the most reliable biometric traits for personal identification. In fact, iris patterns have stable, invariant and distinctive features for personal identification. Reliable authorization and authentication are becoming necessary for many everyday applications. Iris recognition has been paid more attention due to its high reliability in personal identification. But iris feature extraction is easily affected by some practical factors, such as inaccurate localization, occlusion, and nonlinear elastic deformation. The objective of the study and proposed work is to adapt the increasing usage of biometric systems which can reduce the iris preprocessing and describe iris local properties effectively and have encouraging iris recognition performance. This work presents an efficient algorithm of iris feature extraction based on modified scale invariant feature transform algorithm (SIFT) .

Keywords: iris recognition, feature extraction, occlusion, biometric systems, sift.

GJCST-F Classification : I.2.10

SIFTALGORITHMFORIRISFEATUREEXTRACTION

Strictly as per the compliance and regulations of:

© 2014. Kinjal M. Gandhi & Prof. R. H. Kulkarni. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction inany medium, provided the original work is properly cited.

Sift Algorithm for Iris Feature Extraction

Kinjal M. Gandhi [α] & Prof. R. H. Kulkarni [σ]

Abstract- Iris recognition is proving to be one of the most reliable biometric traits for personal identification. In fact, iris patterns have stable, invariant and distinctive features for personal identification. Reliable authorization and authentication are becoming necessary for many everyday applications. Iris recognition has been paid more attention due to its high reliability in personal identification. But iris feature extraction is easily affected by some practical factors, such as inaccurate localization, occlusion, and nonlinear elastic deformation. The objective of the study and proposed work is to adapt the increasing usage of biometric systems which can reduce the iris preprocessing and describe iris local properties effectively and have encouraging iris recognition performance. This work presents an efficient algorithm of iris feature extraction based on modified scale invariant feature transform algorithm (SIFT) .

Keywords: iris recognition, feature extraction, occlusion, biometric systems, sift.

I. Introduction

The recent advances of information technology and the increasing requirement for security have led to a rapid development of intelligent personal identification systems based on biometrics. Biometrics employs physiological or behavioral characteristics to accurately identify an individual. Iris is the best characteristic that can be used for person's identification and authentication in comparison with fingerprints, face, voice, and signature. It combines all the characteristics that a practical biometric should have. Iris pattern is unique to each person even that difference exists between twines. In the same time, the iris pattern is different between the right and left eye of the same person. Moreover, iris is very stable and changeless human characteristic over the time. Also, the sensing device that is used in order to measure the iris characteristic is a camera. This will be convenient for user population. Iris pattern is the safest biometric of all because it cannot be duplicated. The idea of iris identification trace back to the Paris prison in eighteenth century, where police discriminated criminal by inspecting their irises color [3]. The latest threats of security have led to the increased awareness of biometric technologies. Iris recognition is one of the most secure biometric approaches as it is non-invasive and stable throughout life [9][10]. Moreover, it does not require physical contact with the camera. In this way, the hygienic issue is minimized.

Reliable authorization and authentication are becoming necessary for many everyday applications such as boarding an aircraft, performing financial transaction, logging to a secure system etc. Identity verification becomes a challenging task when it has to be automated with high accuracy and with low probability of break-ins and low rates of false match. Moreover, person verification is not a new problem and society had created three traditional modes of designation. Iris recognition has been paid more attention due to its high reliability in personal identification. But iris feature extraction is easily affected by some practical factors, such as inaccurate localization, occlusion, and nonlinear elastic deformation and so on.

In order to solve the problem, this work presents an efficient algorithm of iris feature extraction based on modified scale invariant feature transform algorithm (SIFT)[8]. It analyze the local feature in iris region to make use of the method of local feature matching, which overcomes the overall feature coding disadvantages to iris recognition. It not only to be an effective approach to simplify the iris image preprocessing, but also to solve the difficulties of iris recognition with iris occlusion and also to improve recognition performance efficiently.

II. Review of Related Work

Although there are many proposed iris recognition systems, all of them approximately share the following main stages: iris Segmentation, iris normalization, feature extraction, and feature comparison, as shown in Figure 1.

Daugman's 1994 patent described an operational iris recognition system in some detail. In 2004 his new paper said that image acquisition should use near-infrared illumination so that the illumination could be controlled. Daugman's approximated the pupil and iris boundaries of the eye as circles. So, he proposed an Integro-Differential operator for detecting the iris boundary by searching the parameter space. Because not all images of an iris are in the same size (e.g. The distance from the camera affects the size of the iris in the image, illumination variations and angle of the image capturing), Daugman proposed the rubber sheet model to normalize the segmented iris. This model represents the iris using a fixed parameter interval in a doubly dimensionless pseudo polar coordinate system. The iris is remapped from raw Cartesian coordinates (x,y) to the dimensionless polar coordinate system,

Author α σ: Computer Dept, BSCOER, narhe, pune.
e-mail: kinjalgandhi_50@yahoo.co.in

© 2014 Global Journals Inc. (US)

which consists interval [0,1] and θ is an angle in [0,2π]. This makes all irises have the same size and also simplifies subsequent processing. To extract the features from the normalized iris Daugman applied a two dimensional texture filter called Gabor filter to an image of the iris and extracted a representation of the texture, called the iris code. The iris code is a set of bits, each one of which indicates whether a given band pass texture filter (Gabor filter in Daugman algorithm) applied at a given point on the iris image has a negative or nonnegative result. To compare two iris templates Daugman used Hamming distance as the similarity measure for two iris signatures. Wildes described an iris biometrics system uses different techniques from that of Daugman. To accomplish iris segmentation Wildes used a gradient based binary edgemap construction followed by circular Hough transform Wildes applied a Laplacian of Gaussian filter at multiple scales to produce a template and compute the normalized correlation as a similarity measure after normalizing the segmented iris. He used an image registration technique to compensate scaling and rotation then an isotropic band-pass decomposition is proposed, derived from application of Laplacian of Gaussian filters to the image data. In the Comparison stage a procedure based on the normalized correlation between both iris signatures is used. Although Daugman's system is simpler than Wildes' system, Wildes' system has a less intrusive light source designed to eliminate specular reflections. Wildes' approach is expected to be more stable to noise perturbations, it makes less use of available data, due to binary edge abstraction, and therefore might be less sensitive to some details. Also, Wildes' approach encompassed eyelid detection and localization. Li Ma, Tieniu Tan, Yunhong Wang, and Dexin Zhang proposed a new algorithm for iris recognition by characterizing key local variations. The basic idea is that local sharp variation points, denoting the appearing or vanishing of an important image structure, are utilized to represent the characteristics of the iris. First, the background in the iris image is removed by localizing the iris by roughly determine the iris region in the original image, and then use edge image enhancement is applied to handle the low contrast and non-uniform brightness caused by the position of light sources. In feature extraction stage they constructed a set of 1-D intensity signals containing the main intensity variations of the original iris for subsequent feature extraction. Using wavelet analysis, they recorded the position of local sharp variation points in each intensity signal as features. Directly matching a pair of position sequences is also very time-consuming. So, they adopted a fast matching scheme based on the exclusive OR operation to solve this problem intensity signal as features. Directly matching a pair of position sequences is also very time-consuming. So, they adopted a fast matching scheme based on the exclusive OR operation to solve this problem.

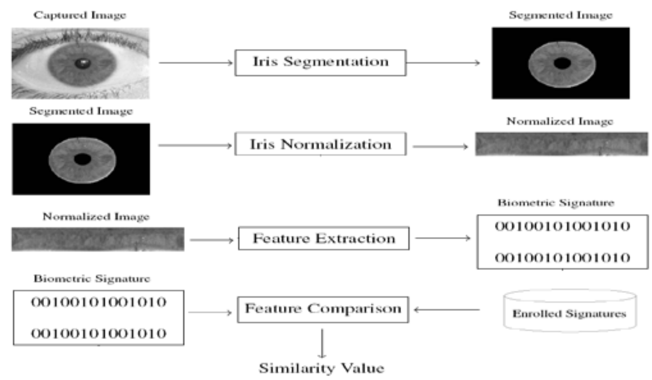


Figure 1 : Main stages of the iris recognition systems

a) Existing Techniques for Iris Recognition

The K-means algorithm is an iterative technique that is used to partition an image into k clusters by assigning each point to the cluster whose center (also called centroid) is nearest. The center is the average of all the points in the cluster that is, its coordinates are the arithmetic mean for each detection and Hough transform to exactly compute the parameters of the two circles in the determined region. Then lighting correction and dimension separately over all the points in the cluster. The basic K-means algorithm we used is:

Compute the intensity distribution (also called the histogram) of the intensities.

The Distance in our algorithm is typically based on pixel intensity. K-means clustering requires to specify the number of clusters to be partitioned and a distance metric to quantify how close two objects are to each other.

The Hough transform is a standard computer vision algorithm that can be used to determine the parameters of simple geometric objects, such as lines and circles, present in an image. It can be described as a transformation of a point in the x, y-plane to the parameter space. The parameter space is defined according to the shape of the object of interest. The circle is actually simple to represent in parameter space, compared to other shapes, since the parameters of the circle can be directly transfer to the parameter space. The circular Hough transform can be employed to deduce the radius and centre coordinates of the pupil and iris regions. It works as follow; at each edge point result from previous edge detection step we draw a circle with center in the point with the desired radius. This circle is drawn in the parameter space Figure 2 shows this process. At the coordinates which belong to the perimeter of the drawn circle we increment the value in our accumulator matrix which essentially has the same size as the parameter space. In this way we sweep over every edge point in the input image drawing circles with the desired radii and incrementing the values in our accumulator. When every edge point and every desired radius is used, we can turn our attention to the accumulator. The accumulator will now contain

© 2014 Global Journals Inc. (US)

numbers corresponding to the number of circles passing through the individual coordinates. Thus the highest numbers selected in an intelligent way, in relation to the radius correspond to the center of the circles in the image.

There are many methods for edge detection, but one of the most optimal edge detection methods is Canny edge detection. It receives a grayscale image and outputs a binary map correspondent to the identified edges. It starts by a blur operation followed by the construction of a gradient map for each image pixel. A non-maximal suppression stage sets the value of 0 to all the pixels of the gradient map that have neighbors with higher gradient values. Further, the hysteresis process uses two predefined values to classify some pixels as edge or non-edge. Finally, edges are recursively extended to those pixels that are neighbors of other edges and with gradient amplitude higher than a lower threshold.

III. SYSTEM ARCHITECTURE

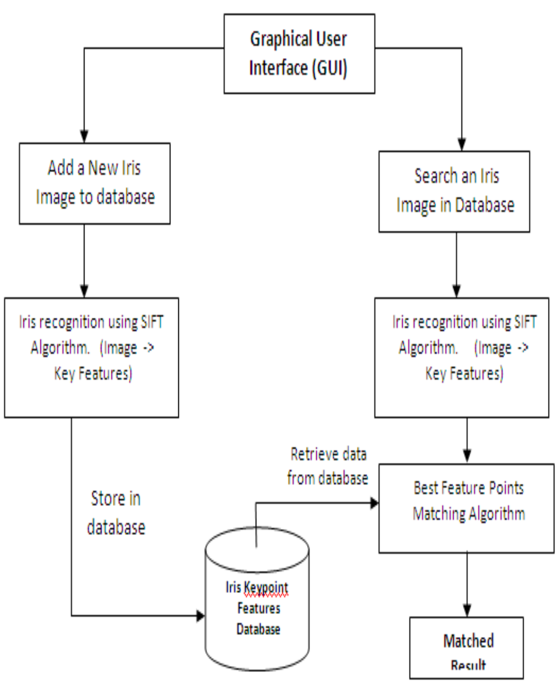


Figure 2 : System Architecture of proposed system

The proposed work implements an efficient method for describing local properties of an image as SIFT as shown in figure-3. The SIFT feature description method is revised appropriately, and is applied to iris recognition. It extracts the feature points which are reliable, stable and diverse. The feature vector is invariant to image translation, scaling, rotation and partially invariant to illumination changes. It can effectively extract the nature feature information of iris veins, so it can solve the traditional problem of low correct identification rate due to occlusion, inaccurate localization and so on. Moreover, it can simplify the iris preprocessing. It also does the satisfactory identification and searching through directly extracting and matching feature from iris images.

a) System Modules

- Iris Acquisition
- Image pre-processing
- Iris Feature Extraction
- Iris Identification

IV. PROBLEM STATEMENT

Reliable authorization and authentication are becoming necessary for many everyday applications such as boarding an aircraft, performing financial transaction, logging to a secure system etc. Identity verification becomes a challenging task when it has to be automated with high accuracy and with low probability of break-ins and low rates of false match. Moreover, person verification is not a new problem and society had created three traditional modes of designation. Iris recognition has been paid more attention due to its high reliability in personal identification. But iris feature extraction is easily affected by some practical factors, such as inaccurate localization, occlusion, and nonlinear elastic deformation and so on. In order to solve the problem, this work presents an efficient algorithm of iris feature extraction based on modified Scale Invariant Feature Transform algorithm (SIFT). It analyze the local feature in iris region to make use of the method of local feature matching, which overcomes the overall feature coding disadvantages to iris recognition. It not only to be an effective approach to simplify the iris image preprocessing, but also to solve the difficulties of iris recognition with iris occlusion and also to improve recognition performance efficiently.

V. ALGORITHM DESIGN

We implement SIFT algorithm for feature extraction and to generate feature vector. SIFT is an efficient method for describing local properties of an image. This implementation tries to extract an image from a collection of keypoints. These are oriented features of the image, so they are invariant to deformation like translation, rotation and scaling. They are partially invariant to change of illumination as well. In SIFT approach, some key points insensitive to illumination, rotation and scale changes are first detected. Then, for each key point, its feature vector is formed using the gradient directions of pixels in a block centered at the point. Hence, each local feature vector is invariant to image translation, scaling, and rotation, and partially invariant to illumination changes. It follows the following methods to generate the features as,

To perform the Iris reorganization and searching based on the feature matching we implemented the

© 2014 Global Journals Inc. (US)

Java Imaging API and SWT kit of eclipse to take advantage to design the interface. We implement the following java classes to achieve the function for evaluation.
The project is implemented in 2 phases as:

a) Phase-1 System Training

To perform the system training we implement the following java classes to generate the feature base for iris recognition. We generate feature database for our proposed SIFT Algorithm and Gabor Filter to evaluate the searching performance. It will be automatically reads all the images provided for training and store the extracted feature into database. We maintain two different database as S Database. iris for SIFT Algorithm and G Database. iris for Gabor filter.

b) Phase-2: Database Searching

To perform the database searching we utilized the features extracted during the training phase. It takes a selected input image for searching and using a selected algorithm approach to extract the image features. The obtained feature will be compared against the database to find the matching.

VI. Mathematical Model

The SIFT keys derived from an image are used in a nearest-neighbour approach to indexing to identify candidate object models. Collections of keys that agree on a potential model pose are first identified through a Hough transform hash table, and then through a least-squares fit to a final estimate of model parameters. When at least 3 keys agree on the model parameters with low residual, there is strong evidence for the presence of the object. Since there may be dozens of SIFT keys in the image of a typical object, it is possible to have substantial levels of occlusion in the image and yet retain high levels of reliability. To achieve rotation invariance and a high level of efficiency, we have chosen to select key locations at maxima and minima of a difference of Gaussian function applied in scale space. This can be computed very efficiently by building an image pyramid with resampling between each level. Furthermore, it locates key points at regions and scales of high variation, making these locations particularly stable for characterizing the image. SIFT is an efficient method for describing local properties of an image. It uses Gaussian kernel scale function which finds the difference of Gaussian image can be computed from the difference of two nearby scales separated by a constant multiplicative factor k in scale space. The Gaussian kernel is used to create scale space as,

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

Where

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

The σ determines the width of the Gaussian kernel, and x, y is the spatial coordinate of image I .Each feature point is assigned a dominant orientation so that the feature vectors describing feature point P(xo, yo), are invariant to rotation.

$$m(x,y)=\sqrt{(L(x+1,y)-L(x-1,y))^2+(L(x,y+1)-L(x,y-1))^2}$$

$$\theta(x,y)=\tan^{-1}((L(x,y+1)-L(x,y-1))/(L(x+1,y)-L(x-1,y)))$$

where L(x, y) is produced from the convolution of a variable scale Gaussian, G(x, y, k σ), with an input image I(x, y).Peaks in the orientation histogram correspond to dominant directions of local gradients. The highest peak in the histogram is detected, and then any other local peak that is within 80% of the highest peak is used to also create a feature point with that orientation.

$$w(x,y)=m(x,y)\exp(-((x-x_0)^2+(y-y_0)^2)/2\sigma^2)$$

Finally, the feature vectors are generated. F(x, y) = (F1, F2... FN) is feature vector of feature point P(xo,yo); N is the number of 4x4 sub-region in feature point region.

VII. Result Discussions

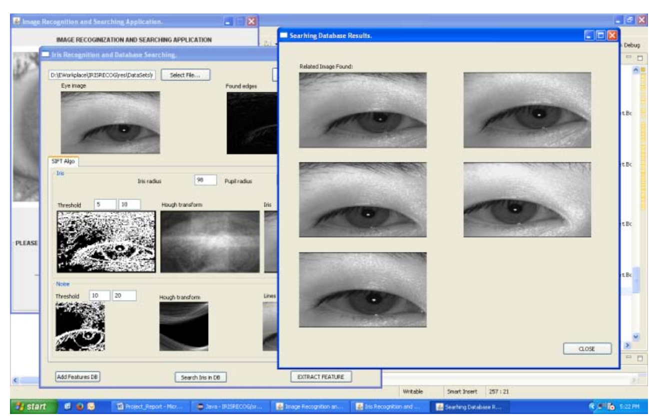


Figure 3 : Search Result of Input Iris with > 80% similarity using SIFT

Figure 4 shows the output search result match of an input image. The obtain result is based on percentage of feature matching. The obtain result is above 80% feature similarity compares to input images. We evaluated the search by varying the feature similarity percentage to > 90% and 100%. The obtained search result is shown below in figure 4 and 5. iris search using

© 2014 Global Journals Inc. (US)

Gabor filter. The obtain result shows a difference in feature matching and result retrieval in compare to SIFT Algorithm. To evaluate further we run this with various different samples and finally we measures the precision and recall ratio.

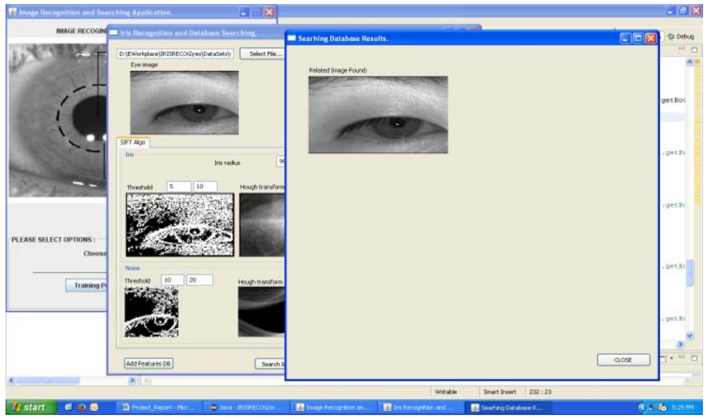


Figure 6 : Search Result of Input Iris with 100% similarity using SIFT

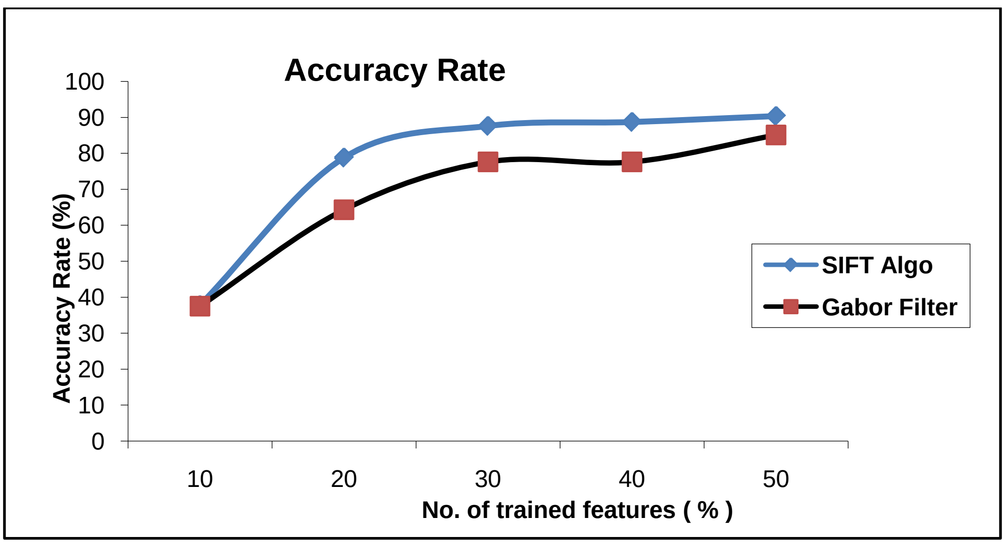


Figure 7 : Rate of accuracy comparison at different trained features

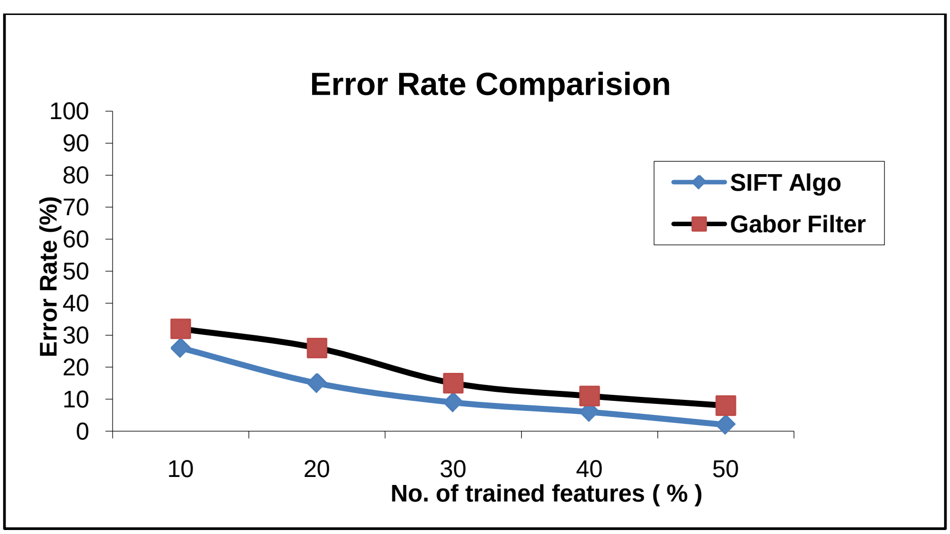


Figure 8 : Error Rate comparison at different trained features

© 2014 Global Journals Inc. (US)

VIII. Conclusion

The requirements of biometric operation in identification mode by exhaustively searching a large database are vastly more demanding than operating merely in one-to one verification mode A major approach for iris recognition today is to generate feature vectors from individual iris images and to perform iris matching based on some distance metrics and most of the commercial iris recognition systems implement a famous algorithm using iris codes proposed by Daugman. We proposed a work is to adapt the increasing usage of biometric systems which can reduce the iris preprocessing and describe iris local properties effectively and have encouraging iris recognition performance using SIFT Algorithm The experiment observation shows that SIFT feature description method is revised and appropriately can be applied to iris recognition. Moreover, it simplifies the iris preprocessing and also does the satisfactory identification and searching through directly extracting and matching feature from iris images. Although the developed system has recorded good results with the data sets presented, there are still some factors to consider if the software was to be used with a hardware camera in future enhancement of this work for a real-time evaluation.

References Références Referencias

1. J. Daugman, High Confidence Visual Recognition of Persons by a Test of Statistical Independence, Pattern Analysis and Machine Intelligence, IEEE Transaction on, Vol. 15, No. 11, pp. 1148-1161, 1993.
2. S. Sanderson, J. Erbetta. Authentication for secure environments based on iris scanning technology. IEE Colloquium on Visual Biometrics, 2000.
3. Y. Huang, et al; An Efficient Iris Recognition System; Proceedings of the First International Conference on Machine Learning and Cybernetics, Beijing, 2002.
4. Padma Polash Paul, Md. Maruf Monwar, “Human Iris Recognition for Biometric Identification”,Ahsanullah University of Science and Technology, Dhaka, Bangladesh.
5. J. Daugman “How iris recognition works” Proceedings of International Conference on image Processing.
6. J. Dugman “New Method of Iris Recognition Based on J.Daugman’s Principle” Second International Conference on Emerging Trends in Engineering and Technology, ICETET-09.
7. L. Ma, T. Tan, Y. Wang, and D. Zhang, “Efficient iris recognition by characterizing key local variations,” IEEE Trans. Image Processing, vol. 13, no. 6, pp. 739–750, June 2004.
8. Lowe, D.G. "Object recognition from local scale-invariant features", In International Conference on Computer Vision, Corfu, Greece, pp. 1150- 1157. 1999.
9. K. Mayazawa, K. Ito, and T. Aoki, "An Efficient IRIS Recognition Algorithm using Phase Based Image Matching". in Proc. Porc. IEEE 2005, 2005
10. S. Elsherief, M. Allam, and M. Fakur, "Biometric Personal Identification base on IRIS Recognition",. in Proc. IEEE 2006, 2006, pp. 208.213.
11. R. Wildes, J. Asmuth, G. Green, S. Hsu, R. Kolczynski, J. Matey, S. McBride. A system for automated iris recognition. Proceedings IEEE Workshop on Applications of Computer Vision, Sarasota, FL, pp. 121-128, 1994.

© 2014 Global Journals Inc. (US)

Global Journals Inc. (US) Guidelines Handbook 2014

www.GlobalJournals.org

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN COMPUTING (FARSC)

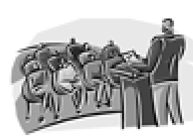
Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards “FARSC” title to individuals. The 'FARSC' title is accorded to a selected professional after the approval of the Editor-in-Chief/Editorial Board Members/Dean.

- The “FARSC” is a dignified title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

FARSC accrediting is an honor. It authenticates your research activities. After recognition as FARSC, you can add 'FARSC' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSC designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.



Once FARSC title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA).The Fellow can also participate in conference/seminar/symposium 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.

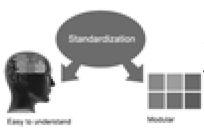
You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

© Copyright by Global Journals Inc. (US) | Guidelines Handbook

The FARSC can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSC, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.



The FARSC will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSC member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSC, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSC members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSC member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

© Copyright by Global Journals Inc.(US)| Guidelines Handbook

The FARSC is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSC can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSC member can decide its price and we can help in making the right decision.

The FARSC member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN COMPUTING (MARSC)

The ' MARSC ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.
The “MARSC” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSC or William Walldroff, M.S., MARSC.

MARSC accrediting is an honor. It authenticates your research activities. After becoming MARSC, you can add 'MARSC' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSC designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSC, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSC member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSC, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

© Copyright by Global Journals Inc.(US)| Guidelines Handbook

Institutional Fellow of Open Association of Research Society (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

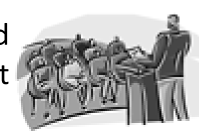
The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.
The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

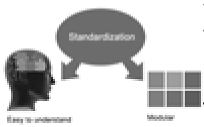


The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.



After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.

The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not convenient, and then email the paper directly to dean@globaljournals.org.

Offline Submission: Author can send the typed form of paper by Post. However, online submission should be preferred.

© Copyright by Global Journals Inc.(US)| Guidelines Handbook

MANUSCRIPT STYLE INSTRUCTION (Must be strictly followed)

Page Size: 8.27" X 11'"

- Left Margin: 0.65
- Right Margin: 0.65
- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, “Abstract” word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

The Global Journals Inc. (US) welcome the submission of original paper, review paper, survey article relevant to the all the streams of Philosophy and knowledge. The Global Journals Inc. (US) is parental platform for Global Journal of Computer Science and Technology, Researches in Engineering, Medical Research, Science Frontier Research, Human Social Science, Management, and Business organization. The choice of specific field can be done otherwise as following in Abstracting and Indexing Page on this Website. As the all Global

Journals Inc. (US) are being abstracted and indexed (in process) by most of the reputed organizations. Topics of only narrow interest will not be accepted unless they have wider potential or consequences.

2. ETHICAL GUIDELINES

Authors should follow the ethical guidelines as mentioned below for publication of research paper and research activities.

Papers are accepted on strict understanding that the material in whole or in part has not been, nor is being, considered for publication elsewhere. If the paper once accepted by Global Journals Inc. (US) and Editorial Board, will become the copyright of the Global Journals Inc. (US).

Authorship: The authors and coauthors should have active contribution to conception design, analysis and interpretation of findings. They should critically review the contents and drafting of the paper. All should approve the final version of the paper before submission

The Global Journals Inc. (US) follows the definition of authorship set up by the Global Academy of Research and Development. According to the Global Academy of R&D authorship, criteria must be based on:

1) Substantial contributions to conception and acquisition of data, analysis and interpretation of the 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.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board's decision on publication of the paper is final and cannot be appealed elsewhere.

Permissions: It is the author's responsibility to have prior permission if all or parts of earlier published illustrations are used in this paper.

Please mention proper reference and appropriate acknowledgements wherever expected.

If all or parts of previously published illustrations are used, permission must be taken from the copyright holder concerned. It is the author's responsibility to take these in writing.

Approval for reproduction/modification of any information (including figures and tables) published elsewhere must be obtained by the authors/copyright holders before submission of the manuscript. Contributors (Authors) are responsible for any copyright fee involved.

3. SUBMISSION OF MANUSCRIPTS

Manuscripts should be uploaded via this online submission page. The online submission is most efficient method for submission of papers, as it enables rapid distribution of manuscripts and consequently speeds up the review procedure. It also enables authors to know the status of their own manuscripts by emailing us. Complete instructions for submitting a paper is available below.

Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications.

Research letters: The letters are small and concise comments on previously published matters.

5. STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(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, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

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

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

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive 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) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

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

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin 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 research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, 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. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. 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: It is the rule of the Global Journals Inc. (US) for authors 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.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

6.2 Early View of Global Journals Inc. (US) (Publication Prior to Print)

The Global Journals Inc. (US) are enclosed by our publishing's Early View service. Early View articles are complete full-text articles sent in advance of their publication. Early View articles are absolute and final. They have been completely reviewed, revised and edited for publication, and the authors' final corrections have been incorporated. Because they are in final form, no changes can be made after sending them. The nature of Early View articles means that they do not yet have volume, issue or page numbers, so Early View articles cannot be cited in the conventional way.

6.3 Author Services

Online production tracking is available for your article through Author Services. Author Services enables authors to track their article - once it has been accepted - through the production process to publication online and in print. Authors can check the status of their articles online and choose to receive automated e-mails at key stages of production. The authors will receive an e-mail with a unique link that enables them to register and have their article automatically added to the system. Please ensure that a complete e-mail address is provided when submitting the manuscript.

6.4 Author Material Archive Policy

Please note that if not specifically requested, publisher will dispose off hardcopy & electronic information submitted, after the two months of publication. If you require the return of any information submitted, please inform the Editorial Board or dean as soon as possible.

6.5 Offprint and Extra Copies

A PDF offprint of the online-published article will be provided free of charge to the related author, and may be distributed according to the Publisher's terms and conditions. Additional paper offprint may be ordered by emailing us at: editor@globaljournals.org .

You must strictly follow above Author Guidelines before submitting your paper or else we will not at all be responsible for any corrections in future in any of the way.

Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. 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.

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

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

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

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

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. 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 to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

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

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

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

© Copyright by Global Journals Inc.(US)| Guidelines Handbook

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After 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 to 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 in 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 criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

© Copyright by Global Journals Inc. (US) | Guidelines Handbook

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 the 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 evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

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

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing 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 approach 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. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than 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 maintain the initial two items to no more than one ruling each.

- Reason of the study - 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 quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness 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 to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled 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 with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose 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 sound written Procedures segment allows a capable scientist to replacement 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 for the least amount of information that would permit another capable scientist to spare 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 object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text 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:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not 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 - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in 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 a 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. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise 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 in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to 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 part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a 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 implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly 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 with prospect, and let it drop at that.

- Make a decision if each premise is supported, 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 the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One 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 available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Administration Rules Listed Before Submitting Your Research Paper to Global Journals Inc. (US)

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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

© Global Journals Inc.