

Prediction of Personality through Hand Geometry and Big Five Factor Model

Ms. Vaishali R. Lokahnde¹, Dr. Bharti W. Gawali²

¹ Department of Computer Science and I.T, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, 431004, India

² Department of Computer Science and I.T, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, 431004, India

Abstract

Human hand portrays the abundant information about different temperamental activities of an individual. Hand analysis provides an efficient way to define the characteristics of a person. It reveals personality characteristics such as openness, agreeableness, extrovert, communicative, idealistic and emotional stability. The proposed system included 50 hand (left and right) shape images. Through the hand geometry the features like palm ratio, finger palm ratio and finger index were extracted and used for categorization of Earth, Air, Water and Fire hand shapes. Distinctive prominent categorizations of personality were categorized through Big five personality. The results obtained were observed to be efficient in predicting the personality of a person.

Keywords: Chiromony, Elemental Hand Shape, Big Five Factor Model, Personality Prediction

1. INTRODUCTION

Every human hand is unique and a mirror which represent the personality of a person. The Palmistry analyses the characteristics of hand including the shape, size, texture, length, width, skin pattern, mounts, finger prints, and fingernails of hand for predicting the future and type of personality. There are two well known branches of palmistry [1]:

- Chiromony which deals with the shape, length and width of human hand.
- Chiromancy which deals with lines on palm

According to chiromony, human hand is broadly divided into four elemental categories; earth hand, fire hand, water hand and air hand. The elemental type is defined by the shape of the palm in relation to the length of the fingers. The shape of hand reflects the one of four elemental archetypes [2]. In the modern world these elemental hand shapes can be differently classified as [4]:

- Earth hand as Practical hand
- Fire hand as Intuitive hand
- Water hand as Sensitive hand
- Air hand as Intellectual hand.

The pattern in the hands helps in revealing the life experiences of the respective human being [5].

2. WORK DONE SO FAR

In the era of modern technology, the hand geometry is mostly used for identification of person. The biometric authentication systems were implemented for the same purpose. Security is the main aim of such kind of implementation. Recently some researchers are now considering the hand geometry for recognition of person.

A research work [6] was conducted on 408 hand templates of 24 people and extracted 21 elements from a hand like length, height and area of finger. Recognition was completed by using Hamming distance, Gaussian Mixture Model and Euclidian distance. Among all three the Gaussian Mixture Model (GMM) got better results with False Acceptance Rate as 0.1812% and Energy Efficiency Ratio as 4.62%. Voronoi technique applied on 260 hand and palm gestures by [7] and got 0.0035% for FAR and 5.7692% for the FRR. Similarly, [8] applied Dynamic Time Warping distance measure with centroid based technique on 128 hand gestures and got results for FAR, FRR and TSR as 23.67%, 23.43% and 76.33% respectively. 500 images were collected from 50 users [9]. The result was based on FRR which was obtained by comparing the features vector of two different hands and got efficiency in accuracy around 97% with ERR of 3%.

The identification of person was considered by [10] using Four finger geometry. The database had 500 pictures of

hand collected from 50 users. The classification was done by using Euclidean distance and absolute distance method. The obtained result was 99.81% accuracy in identification and with 0.1743% EER using the absolute distance classifier. Another system had designed [11] for human identification and verification. The genetic algorithm and mutual information was used to select the best suited features. An experimental evaluation was performed on three public databases GPDS, CASIA and IITD and result obtained was 100% with GPDS and 9% with the remaining databases. [12] had detected ROI, principle lines, center of ROI, reference points and palm length and width, fingers length and distance from center to five top and bottom points of finger. The extracted feature of palm was stored in the database of 100 instances which includes data from five different palm prints. The Naïve classifier had used for the classification of instances. The result of classifier obtained was 70% correctly and 30% incorrectly with 0.2691 roots mean squared error.

An authentication system was developed on Hand geometry [13]. The authentication was done by calculating the measurement of the finger length, finger width, palm width and 10 angel values with respect to area and perimeter were measured. The obtained recognition rate was 91% with mean squared error of 0.00001.

Many researchers focused on palm features for identification of human. The system [14] was tested on 30 palm images of three people (10 images each) to detect the approximated straight lines, curves and circles using Hough Transform and comparison was done among these three people and with among them self too. The system correctly identified a user 77% and correctly rejected the user 90%. This system needs some improvement and was overcome by [15] and developed new feature extraction method on Hong-Kong palm print images. A 2D Gabor Filter method was used to obtain the texture information. The size of database consists of 425 images collected from 95 persons. The performance was calculated under different thresholds which control the False Acceptance Rate and False Rejection Rate values and got 0.91% and 0% accuracy rate respectively.

[16] developed a system which depend on the palm length- width and hand geometry feature to achieve high performance and accuracy for the verification of human in the small organization. 20 features were formed from 300 images of 30 users for the testing of the system. The FAR and FRR values obtained were 0.06 and 0.03 respectively with accuracy rate of 95.5% on a maximum run time of 0.6s and achieved better result. The work based on the segmentation of palm and finger from high resolution images of hand shape and texture to recognize the person was done on 400 hand images, four images per person having age between 16 to 55 years and obtained 96.9% identification rate with FAR values 0.0309, FRR values 0.0312 and EER values 0.0311 [17].

Human personality identification systems also implemented through palm and fingers by few researchers.

A ratio-based system was produced to characterize human characteristics; in the form of positives and negatives through palm width-length [18]. These systems were described for different personality types ruled by different planets had done through comparison of finger length based approach in MATLAB. This approach was tested on palm images of well known personalities like Dalai Lama, Sir Arthur Salivan, Sara Bern Heart, William Whitley, General Sir Redvurse Buller, Benazir Bhutto and so on. The results had obtained with good accuracy and were matched with their own personality.

3. EXPERIMENTAL WORK

The experiment was carried along the following steps and is shown in figure 3.

3.1 Acquisition of an Image

The first step was to capture images of both the hands. The subjects were asked to place both hands on the black flat surface which used as a background. The subjects were requested to place the hands in finger disconnected mode. The hand images were acquired with the camera Canon EOS 1300D- 18 Mega Pixel DSLR with APS-C CMOS sensor and Canon's DIGIC 4+ image processor was used which gives clear photos with little noise. This camera has a wide coverage from low sensitivity to high sensitivity. The images used in this work were stored in .jpg file format. The database was collected for 50 hand images of both the hands, collected from 25 subjects. Among 50 hand images, 25 were considered for training set and 25 for testing set. These images were then further processed through different steps.

3.2 Preprocessing

There are various steps in preprocessing which include gray scale, binarization and filteration. Figure 1 illustrates these steps:

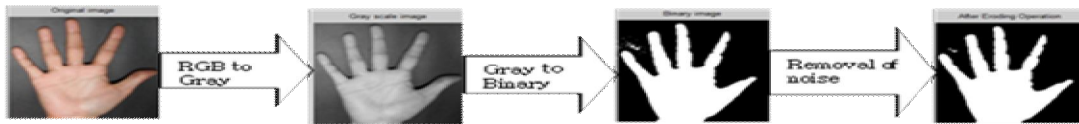


Figure 1 Various steps of preprocessing

3.2.1 Gray Scale Image

An original image is the color image. This RGB image was converted into grayscale image using MATLAB function `rgb2gray()`.

3.2.2 Binary Image

In this stage the gray scale image was converted into binary form with two values 0 and 1, to differentiate between the object and background using `im2bw()`.

3.2.3 Filtered Image

Noise removal from the original image was experimented with morphological operation to enhance the quality of image, an opening and eroding operations are performed.

3.3 Feature Extraction

The proposed system evaluation depends upon palm measurement which includes palm breadth, palm length and palm shape ratio (palm breadth with palm length). The calculation of finger length is achieved by subtracting hand length values with palm length values. Finger-palm ratios were calculated using equation 1.

$$\text{Finger length/palm breadth (fl/pb) and Finger length/palm length (fl/pl)} \tag{1}$$

Equation 2 describes the finger index proportional ratio, to define the categorization of hand shape.

$$\text{Finger length}/((\text{palm breadth} + \text{palm length})/2) \tag{2}$$

Table 1 describes the feature set considered for both hands.

Table1: Feature set for Left and Right Hand

Sr. No.	Name of the Feature
1.	Length of Hand
2.	Length of Palm
3.	Breadth of Palm
4.	Length of middle finger
5.	Ratio of Middle finger length with palm breadth
6.	Ratio of Middle finger length with palm length
7.	Finger Index

The length and width of hand and palm was calculated by using bounding box function in MATLAB, which provides the value of (x1,y1) as starting pixel value and (x2,y2) as ending pixel value of hand and palm, this is helpful for finding length and breadth of hand and palm. Palm can be extracted from the hand by performing morphological operations on hand and this will enhance the feature of palm only.

We were concentrated on the measurement of finger length. This was done by extracting fingers from hand using bounding box on index, middle, ring, pinky finger and thumb. The middle finger length can be obtained by taking difference of hand length and palm length. The process of extraction is shown in figure 2.

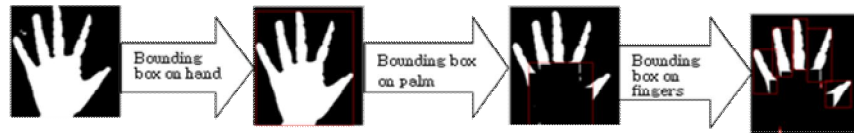


Figure 2 Calculation of length and breadth of hand and palm, length of fingers using Bounding box

After computation the categories for both the hands, can be characterize into four sub categories:

- i. Earth hand: Square palm and Short fingers
- ii. Air hand: Square palm and Long fingers
- iii. Water hand: Rectangular palm and Long fingers
- iv. Fire hand: Rectangular palm and Short fingers

The shape of the palm is categorized by using the formula:

Case 1: If $(pb/pl) < 0.8$ then Rectangular palm

Case 2: If $(pb/pl) > 0.8$ then Square palm

The proposed methodology used for defining the categories of hand:

Step1: Measure hand shape proportions - finger length (fl), palm breadth (pb) and palm length (pl)

Step2: Calculate hand shape ratio: middle finger length/palm length (fl/pl), finger length/palm breadth (fl/pb) and palm shape ratio: pl/pb

Step3: Find 'hand shape profile' via 4 proportional hand shape ratios with the options as follows:

Case 1: If $(fl/pb) < 0.93$ then Earth hand

Case 2: If $(fl/pl) > 0.805$ then Air hand

Case 3: If $(fl/pb) > 1.075$ then Water hand

Case 4: If $(fl/pl) < 0.805$ then Fire hand

Case5: If requirement is not met then this is indicative for a 'Mixed hand' shape profiles.

Step4: Calculate the finger index [3], by using proportional formula:

$$\text{Finger Index} = fl / [(pb + pl) / 2] \tag{3}$$

By applying the formula, categorize the shape of hand as follows:

Case 1: Earth hand = finger index < 0.7675

Case 2: Fire hand = $0.7675 < \text{finger index} < 0.8175$

Case 3: Air hand = $0.8425 < \text{finger index} < 0.8675$

Case 4: Water hand = finger index > 0.8925

Step5: Using Step 3 and Step 4, categorize the shape of the hand.

All mentioned steps are beneficial to define hand shape profile with its predefined characteristics. Figure 3 describes steps of computation.

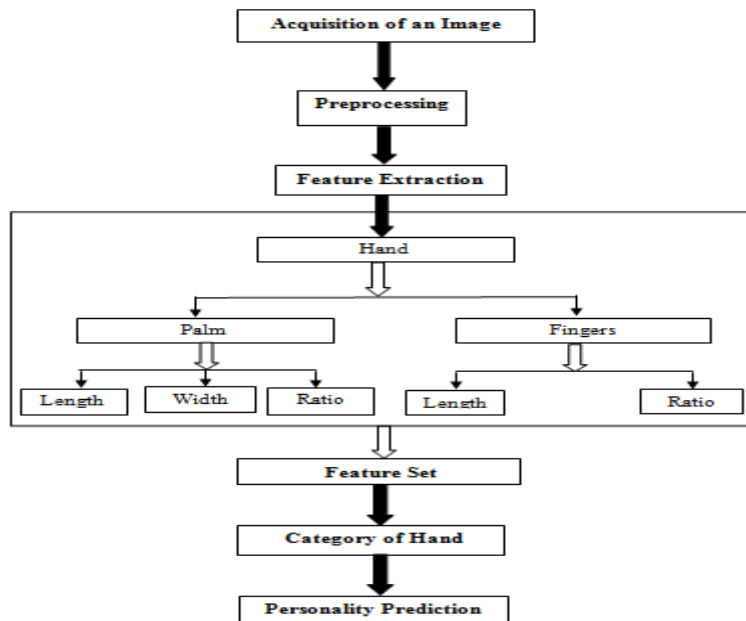


Figure 3 Computational Steps for Prediction of Personality

The Table 2 and Table 3 elaborate the categorization of hand shape with respect to finger-palm ratio, finger proportional index for left and right hand respectively.

Table 2: Categorization of Left Hand through Measurements of palm, finger-palm and finger-index

Sr. No	Subjects	Left Hand Length	Palm Measurements		Palm Ratio	finger length(fl)= hand length-palm length	Finger-Palm ratio		Finger Index= $\frac{fl}{[(pb+pl)/2]}$	Category of hand
			palm breadth (pb)	palm length (pl)	pb/pl		fl/pb	fl/pl		
1	S1	1873	1141	1152	0.9905	721	0.6319	0.6259	0.6289	Earth
2	S2	2177	1527	1195	1.2778	982	0.6431	0.8218	0.7215	Earth
3	S3	1360	770	760	1.0132	600	0.7792	0.7895	0.7843	Fire
4	S4	1815	1210	1269	0.9535	546	0.4512	0.4303	0.4405	Earth
5	S5	2165	1064	1323	0.8042	842	0.7914	0.6364	0.7055	Earth
6	S6	2020	1020	1185	0.8608	835	0.8186	0.7046	0.7574	Earth
7	S7	1948	1073	1110	0.9667	838	0.7810	0.7550	0.7678	Fire
8	S8	1743	892	981	0.9093	762	0.8543	0.7768	0.8137	Fire
9	S9	2083	1136	1292	0.8793	791	0.6963	0.6122	0.6516	Earth
10	S10	2043	1143	1221	0.9361	822	0.7192	0.6732	0.6954	Earth
11	S11	2132	1080	1176	0.9184	956	0.8852	0.8129	0.8475	Air
12	S12	1993	922	1146	0.8045	847	0.9187	0.7391	0.8191	Fire
13	S13	2148	1108	1286	0.8616	862	0.7780	0.6703	0.7201	Earth
14	S14	2107	1099	1187	0.9259	920	0.8371	0.7751	0.8049	Fire
15	S15	2353	1259	1383	0.9103	970	0.7705	0.7014	0.7343	Earth
16	S16	2262	1002	1358	0.7378	904	0.9022	0.6657	0.7661	Earth
17	S17	2035	1033	1218	0.8481	817	0.7909	0.6708	0.7259	Earth
18	S18	2050	1158	1222	0.9476	828	0.7150	0.6776	0.6958	Earth
19	S19	2165	1035	1292	0.8011	873	0.8435	0.6757	0.7503	Earth
20	S20	1936	926	999	0.9269	937	1.0119	0.9379	0.9735	Water
21	S21	2188	1085	1271	0.8537	917	0.8452	0.7215	0.7784	Fire
22	S22	2165	1064	1323	0.8042	842	0.7914	0.6364	0.7055	Earth
23	S23	2165	1034	1280	0.8078	885	0.8559	0.6914	0.7649	Earth
24	S24	2035	1140	1205	0.9461	830	0.7281	0.6888	0.7079	Earth
25	S25	2372	1302	1418	0.9182	954	0.7327	0.6728	0.7015	Earth

Table 3: Categorization of Right Hand through Measurements of palm, finger-palm and finger-index





Sr. No	Subjects	Right Hand Length	Palm Measurements		Palm Ratio	finger length(fl)= hand length-palm length	Finger-Palm ratio		Finger Index= $\frac{fl}{[(pb+pl)/2]}$	Category of hand
			palm breadth (pb)	palm length (pl)	pb/pl		fl/pb	fl/pl		
1	S1	1951	1173	1122	1.0455	829	0.7067	0.7389	0.7224	Earth
2	S2	1459	901	930	0.9688	529	0.5871	0.5688	0.5778	Earth
3	S3	1379	776	761	1.0197	618	0.7964	0.8121	0.8042	Fire
4	S4	1790	1190	1199	0.9925	591	0.4966	0.4929	0.4948	Earth
5	S5	2131	1035	1311	0.7895	820	0.7923	0.6255	0.6991	Earth
6	S6	2017	1099	1189	0.9243	828	0.7534	0.6964	0.7238	Earth
7	S7	1950	1072	1111	0.9649	839	0.7826	0.7552	0.7687	Fire
8	S8	1731	904	990	0.9131	741	0.8197	0.7485	0.7825	Fire
9	S9	2080	1145	1289	0.8883	791	0.6908	0.6137	0.6500	Earth

10	S10	2008	1116	1193	0.9355	815	0.7303	0.6832	0.7059	Earth
11	S11	2134	1093	1187	0.9208	947	0.8664	0.7978	0.8307	Air
12	S12	1987	918	1140	0.8053	847	0.9227	0.7430	0.8231	Air
13	S13	2092	1095	1227	0.8924	865	0.7900	0.7050	0.7450	Earth
14	S14	2100	1088	1178	0.9236	922	0.8474	0.7827	0.8138	Fire
15	S15	2362	1300	1400	0.9286	962	0.7400	0.6871	0.7126	Earth
16	S16	2186	1049	1313	0.7989	873	0.8322	0.6649	0.7392	Earth
17	S17	2073	1142	1272	0.8978	801	0.7014	0.6297	0.6636	Earth
18	S18	2037	1218	1290	0.9442	747	0.6133	0.5791	0.5957	Earth
19	S19	2157	1101	1300	0.8469	857	0.7784	0.6592	0.7139	Fire
20	S20	1895	939	989	0.9494	906	0.9649	0.9161	0.9398	Water
21	S21	2192	1078	1280	0.8422	912	0.8460	0.7125	0.7735	Fire
22	S22	1976	899	1135	0.7921	841	0.9355	0.7410	0.8269	Air
23	S23	2184	1095	1304	0.8397	880	0.8037	0.6748	0.7336	Earth
24	S24	1935	1032	1157	0.8920	778	0.7539	0.6724	0.7108	Earth
25	S25	2290	1248	1374	0.9083	916	0.7340	0.6667	0.6987	Earth

4. RESULT ANALYSIS

The categorization of elemental type of hand was computed through palm ratio and finger-palm ratio. Equation 1 and 2 were beneficial for the categorization of elemental hand type. The experimental result for prediction of personality with respect to characteristics of hand is mentioned in the Table 4.

Table 4: Experimental Result for Prediction of Personality through palm ratio, finger-palm ratio and finger-index

Hand Shape	Characteristics	Category of hand	Personality	No. of Person	Prominent Categorization of Personality
	short finger length & square palm shape	Earth Hand	Responsible, materialistic, conscious, stable, practical, peaceful, have broad interests, tolerance and constructive, independent	17	Conscientiousness
	short finger length & rectangular palm shape	Fire Hand	Excitable, reactive, expansive and energetic, motivated, passionate, intuitive	5	Extraversion
	long finger length & square palm shape	Air Hand	Plenty of intellectual stimulation, independent, private, detached, controlled, creative and passionate, cheerful	2	Openness
	long finger length & rectangular palm shape	Water Hand	Adaptable, idealistic, highly sensitive, highly creative, delicate, secretive and protective	1	Agreeableness

5. CONCLUSION

This proposed system reveals the personality of a person through hand geometry and categorizes them as Earth, Fire, Air and Water hand shapes. The standard Big Five factor model was used to elucidate the major five characteristics of a person is reported and predicted the dominant personality. The experiment results for 25 subjects were calculated and it was observed that 17 subjects belonged to Earth hand, 5 subjects belonged to Fire hand, 2 subjects belonged to Air hand

and 1 belonged to Water hand. The characteristics of these hand shapes were also mapped through Big Five factor model. The features so obtained for 17 earth hand person, 5 fire hand person, 2 air hand person and 1 water hand person were similar both through Chirognomy and Big Five factor model. The study thus established the authenticity of palm ratio, finger-palm ratio and finger index in personality assessment.

The significance of this work is that it can be helpful for the common society, as this work can help to improve the quality, while the recruitment of employees by human resource department in any government or private sector easily. It can also be used to recognize area of interest of the student at school level and thus may be helpful to give direction for their further study for a brighter future.

References

- [1] Nisha Ghai, "Palmistry Guide –An easy way to learn Palmistry", based on New Theory by Palmistry Guru Dyanand Verma, published by Books For All, Printed at D K Fine Art Press P Ltd. Delhi-110052.
- [2] Prof. Anthony Writer, "Palmistry (Part-IV)-A Compilation", Notes for students of Jyotisha Bharati, Bharatiya Vidya Bhavan, Mumbai.
- [3] <http://www.handresearch.com/news/elemental-hand-shapes-earth-fire-air-water-proportions.htm>
- [4] Glen Park Branch, San Fransisco Public Library, "Predicting Your Future", Manufactured in the United States of America , First Ballantine Books Edition:October 1983.
- [5] Sanjay Bensaali, "Palmistry, the complete Jotidh(Hindi word for Palmistry) guide" (downloaded on 22/06/2016)
- [6] Varchol P., Levicy D., "Using of Hand Geometry in Biometric Security Systems", Radio engineering, Vol. 16, No. 4, Pg No 82-87, Dec 2007.
- [7] Wei C. W., W. Shiung, "Biometric Recognition By Fusing Palm-print and Hand Geometry Based on Morphology", IEEE National Chi Nan University, 978-1- 4244-2354, 2009 .
- [8] Vit N. ,Chotirat A.R., "Making Hand Geometry System More Accurate Using Time Series Representation with R-KB and Learning", Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue -6, January 2013.
- [9] AmandeepKaur Bhatia, SupreetKaur Gujral, "Authentication Using Hand Geometry And Finger geometry biometric Techniques", International Journal of Computer Trends and Technology (IJCTT), Vol 4, Issue 8, August 2013, Pg No. 2776-2781
- [10] Bahareh Aghili,, Hamed Sadjedi, "Personal Identification/Verification by Using Four Fingers", Third International Congress on Image and Signal Processing, IEEE, Pg no. 2619-2623, 2010.
- [11] Rafael M. Luque-Baena, David Elizondo, Ezequiel Lopez-Rubio, Esteban J. Palomo, Tim Watson, "Assessment of Geometric Features for Individual Identification and Verification in Biometric Hand Systems", Expert Systems with Applications, Pg No. 3580-3594,2013.
- [12] Hosne-Al-Walid, Tasnia Sadia, Anika Tahsin, Tanzima Asad, Nishat Tasnim, "Palm Print Recognition System using Naïve Bayes Classifier and Image Processing Tool", Communication on Applied Electronics(CAE), Foundation of Computer Science FCS, New York, USA, Volume 2-No.6, August 2015, Pg No.45-49.
- [13] Dr. Firas M.M., Al-Fiky, Zainab Salih Ageed, "Authentication System Depend on Hand Geometry Using Back Propagation Neural Network", International Journal of Information Technology and Business Management, 29Aug 2014, Vol. 28 No.1, Pg No74-119.
- [14] W. W. Boles and S. Y. T. Chu,"Personal Identification Using Images of the Human Palm", Signal Processing Research Centre School of Electrical and Electronic Systems Engineering Queensland University of Technology, w.boles@qut.edu.au, 1997 IEEE TENCON - Speech and Image Technologies for Computing and Telecommunications.
- [15] Kong, W. K., and Zahnag, D.,"Palmpoint Texture Analysis based on Low-Resolution Images for Personal Authentication.", Biometric Research Center, Department of Computing. The Hong Kong Polytechnic University, Kowloon,HongKong, Published by the IEEE.
- [16] Irfan Ahmad, Zahoor Jan, Inayat Ali Shah, Jamil Ahmad, "Hand Recognition Using Palm and Hand Geometry Features", Sci. Int. (Lahore), Vol 27, No. 2, Pg. No-1177-1181. ISSN 1013-5316
- [17] Momna Asghar, Irfan Ashad, Imtiaz Ahmad Taj, Gulistan Raja, and Ahmad Khalil Khan, "Palm and Finger Segmentation of High Resolution Images using Hand Shape and Texture", Proceedings of the Pakistan Academy of Sciences: A Physical and Computational Science, ISSN: 2518-4245 (print), Pg No. 401-416
- [18] Vishwaratna Nigam, Divakar Yadav, "A Novel Approach for Hand Analysis Using Image Processing Techniques", International Journal of Computer Science and Information Security (IJCSIS), January 2010.

AUTHOR



Ms. Vaishali Rustam Lokhande is a Ph.D Student in the Department of Computer Science and Information Technology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, MS, India. She received Master of Philosophy (M.Phil) degree in Computer Science 2015 from Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, MS, India. Her area of interest is Image Processing.



Prof. (Dr.) Bharti Gawali is presently working as a Professor and Head in the Department of Computer Science and Information Technology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, MS, India. She is a Fellow and Hony. Secretary of IETE Aurangabad Center. She is Member of IEEE, IACSIT and ACM. She is reviewer and editor of several journals and Conferences at National & International level. She has organized several technical workshops and conferences. She got DST Fast Track Young Scientist Award and Shikshak Pratibha Puraskar . Her areas of specialization are Speech Processing, Image Processing, HCI, Pattern Recognition, Brain Computer Interface, Networking, Data mining, Biometric, Neuroscience, Remote Sensing and GIS etc.