Sridhar Seshadri* et al.
(IJITR) INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY AND RESEARCH
Volume No.7, Issue No.5, August-September 2019, 9299-9305.

Cognitive Science to Deduct the Classification of Facial Image, Face Verification and Age Estimation

Prof. SRIDHAR SESHADRI
Former Vice Chancellor, Dr K N Modi University Rajasthan

Abstract: **This chapter deals with the following:- Cognitive Science is used To classify using DTOD; verify with training set using Maximum Likelihood Classifier; calculate human age with BPNN and to know parameters with respect to the classification of facial image, verification and estimation**

Key words: **DTOD; BPNN; MLC; Classification; Facial Image; Estimation; Training Set; Human Age**

I. INTRODUCTION

Nowadays a good contribution from the research community is done in the field of Cognitive Science . Three kinds of approaches exist for classification and recognition of human face. The Databases of faces (ORL dataset) i.e. (Olivetti & Oracle Research Laboratory) and the UCD (University College Dublin) dataset are used in the proposed work. ORL is freely downloadable from the website. The occluded datasets are downloaded from UCD dataset.

II. OBJECTIVES AND SCOPE OF USING COGNITIVE SCIENCE

Using Cognitive Science, we deal with the following:-

- To classify using DTOD
- To verify with training set using Maximum Likelihood Classifier
- To calculate human age with BPNN
- To know parameters of proposed work with respect to the classification of facial image, verification and estimation

III. RESEARCH WORK BASED ON COGNITIVE SCIENCE

The existing system is studied and analyzed to formulate the stages in the proposed work as follows:-

- Apply the DTOD classifier with Maximum Likelihood Classifier (MLC)
- Create an effective system for face verification
- Classify the age of a human using BPNN

1. Architecture for Proposed Method to combine three stages

Figure 1 indicates how to combine aforesaid stages.

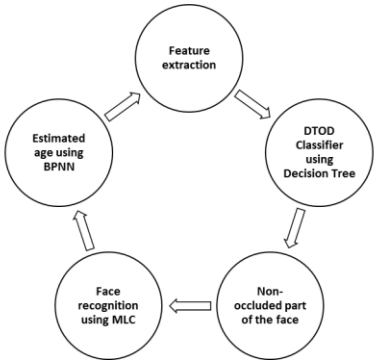

Figure 1

3.2 Methodology using Cognitive science

Methodology for the Proposed work to combined all the stages is shown in Figure 2 as follows:-

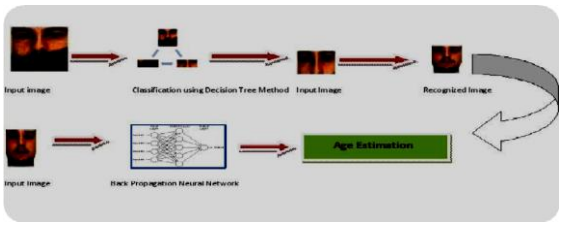

Figure 2

3.3 Classification with DTOD classifier

Work flow diagram is available in Figure 3.

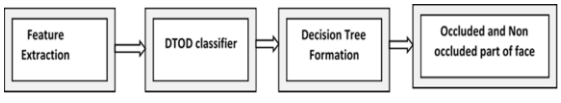

Figure 3

3.4 Occlusion Detection using DTOD classifier

Now,

$$E(S/A) = \sum_{j=1}^{v} P_j' \sum_{i=1}^{m} P_{ij} \log_2 P_{ij}$$

(S : test data , n : sample set. I = 1,2,3 …m. P_i P_{ij} , proportions)

$$P_i = n_i / [S]$$

$$P_{ij} = n_{ij} / [Sj]$$

Step 1 : Scan input image

Step 2 : Find out confidence measure

Step 3 : Deduct face or non face

Step 4 : Linear Discriminant Analysis is used for integration

Step 5 : Maximum likelihood classifier is applied to accept non-occluded face or occluded face . (see Figure 4)

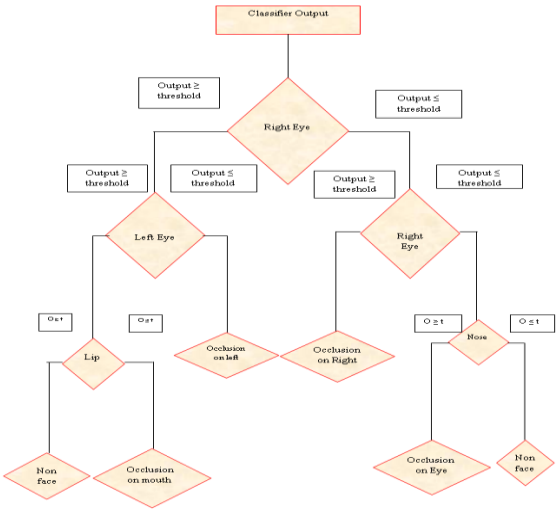

Figure 4

3.5 Face Recognition with MLC

Figure 5 gives clarity to recognize image

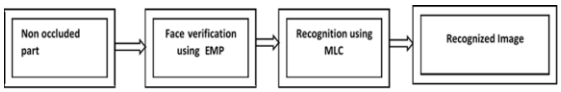

Figure 5

Figure 6 gives the flow to identify face.

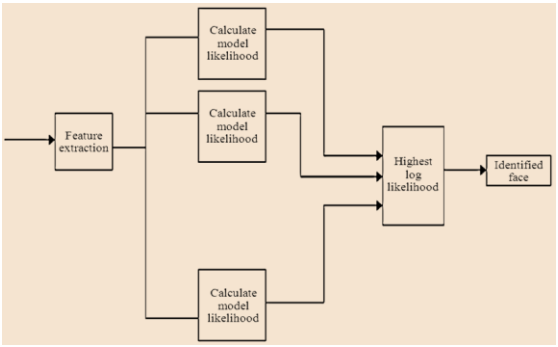

Figure 6

3.6 Age Estimation using BPNN (Figure 7)

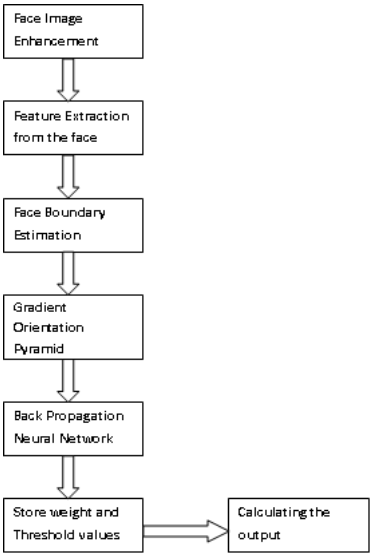

Figure 7

3.7 Training and Learning

Wrinkles starts from first position of forehead like a_{ij}. The first position in the Matrix is starting from a_{ij} , ie the wrinkles start position where i=1, j=1 where $\Delta = 1$. Similarly the remaining values are calculated.

$$a_{ij} = 0, j < i$$

$$a_{ij} = 0, j > i + \Delta$$

where $\Delta = 1$

$$A = \begin{bmatrix} a_{11} & a_{12} & 0 & 0 & 0 \\ 0 & a_{22} & a_{23} & 0 & 0 \\ 0 & 0 & a_{33} & a_{34} & 0 \\ 0 & 0 & 0 & a_{44} & a_{45} \\ 0 & 0 & 0 & 0 & a_{55} \end{bmatrix}$$

$$a_{NN} = p,$$

while $a_{Ni} = 0 \ for \ i < N \ and \ i > N+1$ and initial state probability (π) is defined as

$$\pi_i = [1,0,0,0,0,0]$$

Finally the wrinkles position is calculated and it belongs to a particular face boundary. A is the feature matrix, B is the face boundary ie appropriate class name. $\pi_i = [1,0,0,0,0,0]$ is the probability of the estimated age gap. Suppose 1 belongs to 40-50 then the age gap belongs to 40-50. Based on the face boundary the age group is calculated. Consider wrinkle as the additional parameter to find the exact age of a human.

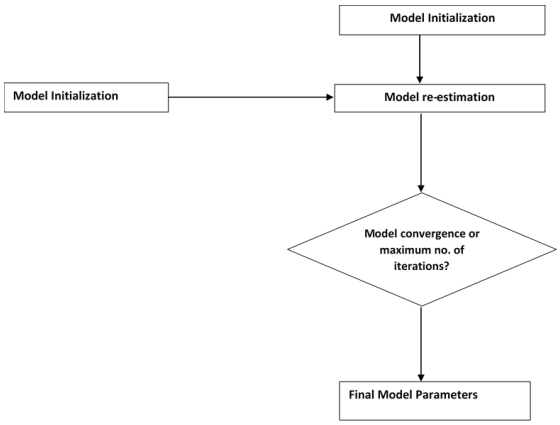

Figure 8

The re-estimation procedure can be applied when the age belongs to specific group of age intervals. The accurate age esitmation is carried out using the above algorithm for re-estimation. (See Figure 8)

IV. RESULTS

Figure 9 shows the canny edge detection which has been performing better result for edge detection. All images from Figure 9 to 16 are published by Authors.

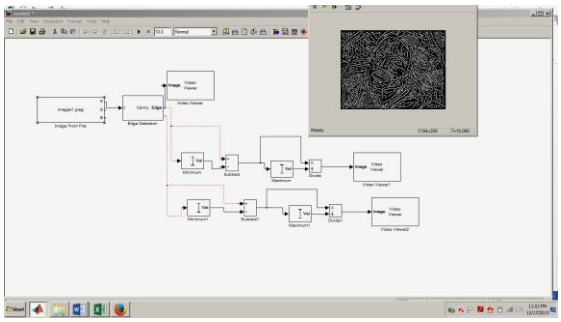

Figure 9

Occluded part in the image is not used for the next stage. The non-occluded part only is taken into considered. Full face is considered in the above results as an input image.

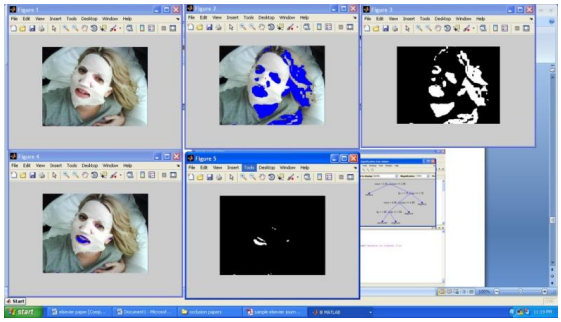

Figure 10

The mouth occluded part is an input and the feature extraction and their decision tree structure shown in the above Figure 10

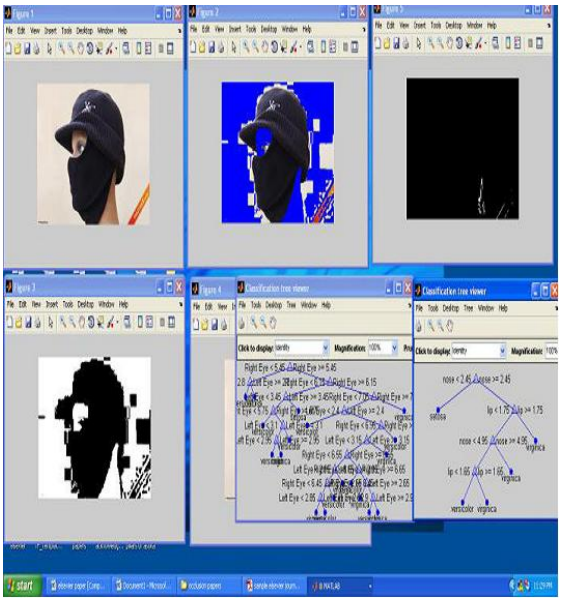

Figure 11

Face Recognition with MLC

Input taken from the ORL dataset and training and testing images are separated. Training image is given as an input and the collection of images are used to test the network. (Figure 11)

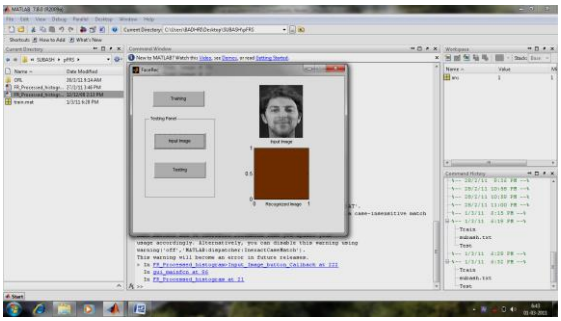

Figure 12

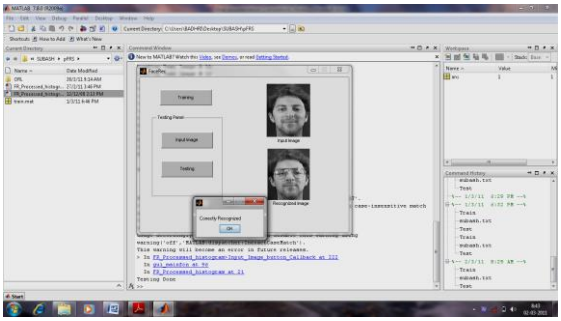

Figure 13

Age estimation of human is calculated using back propoagation netural network algorithm. The age is classified into groups and the above image belongs to the young group of images and the age is 20 and 40. (Figure 12, 13)

Estimated age of a Human (Figure 14)

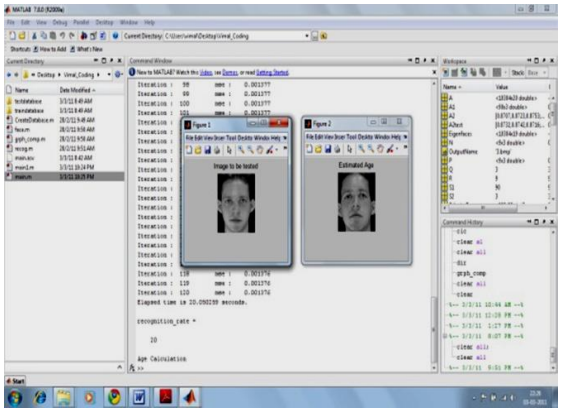

Figure 14

Figures 15 and 16 deal with comparative analysis fo classifier

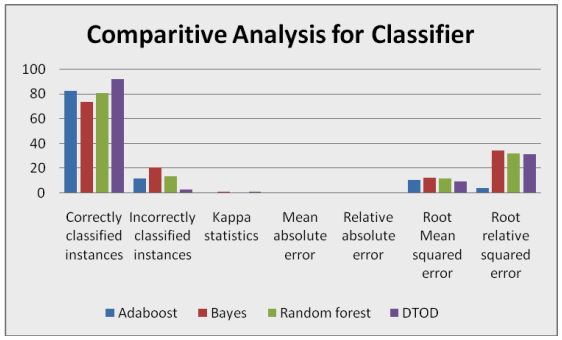

Figure 15

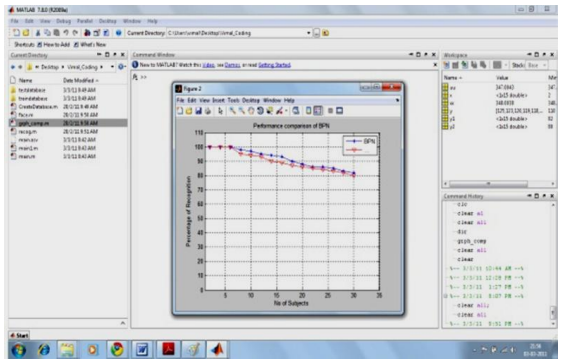

Figure 16

V. CONCLUSIONS

Thus we find that Cognitive Science is used to classify through DTOD; verify with training set using Maximum Likelihood Classifier; calculate human age with BPNN and to know parameters with respect to the classification of facial image, verification and estimation

VI. REFERENCES

[1] Muhammad Naeem Ahmed Khan, Sheraz Ahmed Qureshi and Naveed Riaz (2013) "Gender classification with Decision Trees", International Journal of signal processing, Image processing and pattern recognition, Vol. 6, No. 1, PP: 165-176.

[2] A.Saravanan, Dr.P.Nagarajan (2013), "Performance of ANN in Pattern Recogniton for process improvement using Levenburg-Marquardt and Quasi-Newton algorithms", IOSR Journal of Engineering, Vol.3.No.3, PP:08-13.

[3] Mark Culp, Kjell Johnson, George Michailidis (2013), "Ada : an R Package for Stochastic Boosting", Journal of Statistical Software, Vol.54.No.2, PP:1-26.

[4] Sushma Jaiswal S, Dr.Sarita Singh Bhadauria and Dr.Rakesh Singh Jadon (2011) "Morphologicalmethod, PCA and LDA with neural networks face recognition", Journal of Global Research in Computer Science, Vol 2, No. 6, PP: 35-47.

[5] Nabil Hewahi, Aya Olwan, Nebal Tubeel, Salha EL-Asar, Zeinab Abu-Sultan (2010) "Age Estimation based on Neural Networks using Face Features" Journal of Emerging Trends in Computing and Information Sciences Vol. 1, No. 2, PP: 61-67.

[6] Haibin Ling, soatto S, Ramanathan N and Jacobs D.W (2010) "Face verification across age progression using discriminative methods", IEEE Transactions on Information Forensics and security, Vol.5, No.1, PP:82-91.

[7] Gayathri Mahalingam and Chandra Kambhamettu, (2010), "Face verification with aging using AdaBoost and local binary patterns", Proceedings of the 7th Indian Conference on Computer Vision, Graphics and Image Processing, PP: 101-108.

[8] Ramesha K, Raja K. B, Venugopal K. R and Patnaik L. M (2010), "Feature extraction based face recognition, gender and age classification", International Journal of Computer science and Engineering, Vol. 2, No.1S, PP: 14-23.

[9] Gahyun Kim, Jae Kyu Suhr, Ho Gi Jung, Jaihie Kim (2010)," Face Occlusion Detection by using B-Spline Active Contour and Skin Color Information",11th International Conference Control, Automation, Robotics and Vision, Singapore.

[10] Duan Xiao-dong, Wang Cun-rui, Liu Xiang-dong, Li Zhi jie, Wu Jun, Zhang Hai-long (2010) "Ethnic Features extraction and Recognition of human faces", 2nd International Conference on Advanced Computer Control, PP:125-130.

[11] Mohamed Y.El Dib and Motaz El-Saban (2010), "Human Age Estimation using Enhanced Bio-Inspired Features (EBIF)", International Conference on Image Processing, Vol. 1, PP:1589-1592.

[12] M.Chandra Mohan, V.Vijaya Kumar, B.Sujatha (2010), "Classification of Child and Adult Based on Geometric Features of Face Using Linear Wavelets", Internationl Journal of Signal and Image Processing, Vol.1. No.3, PP:211-220.

[13] Ichikawa K, Mita T, Hori O and Kobayashi T (2008), "Component-Based Face Detection Method for Various types of Occluded Faces", 3rd International symposium on communication, control and signal processing, PP: 538-543.

[14] Nutao Tan, Lei Huang and Changping Liu (2008) "Face Recognition Based on a single image and local binary pattern", Proceedings of the 2nd International Symposium on Intelligent Information Technology puplications, PP: 366-370.

[15] Yun Fu, Student Member, IEEE, and Thomas S, Huang, Life Fellow (2008), "Human Age Estimation With Regression on Discriminative Aging Manifold", IEEE Transactions on Multimedia Vol 10.No. 4, PP:578-584.

[16] Hironobu Fukai, Yuuki Nishie, Kohki Abiko, Yasue Mitsukura, Minoru Fukumi, Masahiro Tanaka (2008), "An Age Estimation System on the AIBO", International Conference on Control, Automation and Systems, PP:2551-2554.

[17] Xin Geng, Zhi-Hua Zhou, Kate Sith Miles (2008), "Individual Stable Space: An Approach to Face Recognition Under Uncontrolled Conditions", IEEE Transactions on Neural Networks, PP:1-15.

[18] Eyal Kolman and Michael Margaliot (2008), "A New Approach to Knowledge –Based Design of Recurrent Neural Networks", IEEE Transactions on Neural Networks, PP:1-13.

[19] Xin Geng, Zhi-Hua Zhou, Smith-Miles, K (2007) " Automatic Age Estimation Based on Facial Aging Patterns" IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 29, No.12, PP: 2234-2240.

[20] Haibin Ling, soatto S, Ramanathan N and Jacobs D.W (2007), "A study of face recognition as people age", IEEE 11th International conference on Computer Vision, PP: 1-8.

[21] Shengcai Liao, Xiangxin Zhu, Zhen Lei, Lun Zhang, Stan z.Li (2007), "Learning Multi-scale Block Local Binary Patterns for Face Recognition", Springer Verlag Lecture Notes in Computer Science , PP:828-837.

[22] KYY Ng, KYL Hon, TMC Lee (2007), "Ageing effect on face recognition", Asian Journal of Gerontology and Geriatrics, Vol.2.No.2, PP:83-98.

[23] Shu Liao, wei fan, Chung and Dit-Yan Yeung (2006), "Facial expression recognition using advanced local binary patterns, tsallis entropies and global appearance features" International conference on Image processing PP: 665-668.

[24] Shu Liao and Albert C.S. Chung (2006), " Texture classification by using Advanced Local Binary Patterns And Spatial Distribution of Dominant Patterns", IEEE Conference on Acoustics, Speech and Signal Processing (ICASSP), PP:1221-1224.

[25] Narayanan Ramanathan, Rama Chellappa (2006), "Modeling Age Progression in Young Faces", IEEE Computer Society Proceedings of the conference on Computer Vision and Pattern Recognition, Vol. 1, PP: 387-394.

[26] Kazuya Ueki, Teruhide Hayashida and Tetsunori kobayshi (2006), "Subspace – based Age-group classification using Facial Images under various Lighting Conditions", Seventh International Confernece on Automatic Face and Gesture Recognition, Vol 1, PP:43-48.

[27] Boualleg, A.H Bencheriet Ch: Tebbikh H (2006), "Automatic Face Recognition using Neural Networks-PCA" , Information and Communication Technologies (ICTTA), Vol.1 PP:1920-1925.

[28] J.Shi, A.Samal, D.Marx, (2006), "How Effective Are Landmarks and their Geoetry for Face Recognition", Computer Vision and Image Understanding, Vol.102.No.2 PP:117-133.

[29] Guillaue Hesuch, Yann Rodriguez and Sebastien Marcel (2006), "Local Binary Patterns as an Image preprocessing for Face Authentication", Proceedins of the Seventh International Conference on Automatic Face and Gesture Recognition, PP:6-14.

[30] X.Tan, S.C Chen, Z-H Zhou, F.Zhang (2005) "Recognizing partially occluded expression variant faces from single training image per person with SOM and soft KNN ensemble", IEEE Tranactions on Neural Networks, PP: 875-886.

[31] S.K.Zhou and R.Chellappa (2005), "Image Based Face Recognition under illumination and pose variations", Journal of the Optical Society of America, Vol.22, PP:217-229.

[32] R.Gross, S.Baker, I.Matthews, T.Kanade, (2004), "Face Recognition across pose and illumination" in Handbook of Face Recognition New York, Springer.

[33] A.Lanitis, C.Draganova, C.Christodoulou (2004), "Comparing different classifiers for automatic age estimation", IEEE Transactions on Systems, Man and Cybernetics, Vol.34.No.1 PP:621-628.

[34] Andreas Lanitis, Chrisina Draganova, Chris Christodoulou (2004), "Comparing Different Classifiers for Automatic Age Estimation", IEEE Transactions on System, Man and Cybernetics, Vol.34, No.1, February PP:621-628.

[35] G.H.Givens, J.R.Beveridge, B.A.Draper, P.Grother, P.J.Philips (2004), "How features of the human face affect recognition: A statistical comparision of three face recognition algorithms", Proceedings of Int. Conf. Pattern Recognition, Vol.2. PP: 381-388.

[36] M.Gandhi, (2004) "A method for automatic synthesis of Ages Human Facial Images", M.S.Thesis, McGill Univ, Montreal, QC, Canada

[37] V.Blanz, T.Vetter (2003), "Face Recognition based on fitting a 3D morphable model", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol.25.No.9, PP:1063-1074.

[38] M.J.Jones and J.M Regh (2002), "Statistical color models with application to skin detection", Int Journal of Computer Vision, Vol.46.No.1. PP:81-96.

[39] Lanitis, C.J.Taylor, T.F.Cootes (2002), "Toward automatic simulation of aging effects on face images", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol.24.No.4, PP:442-455.

[40] P.J.Philips, H.Moon, S.A.Rizvi, and P.J.Rauss (2000), "The FERET evaluation methodology for face-recognition algorithms", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol.22.No.10. PP:1090-1104.

[41] Y.H.Kwon, N.da Vitoria Lobo (1999), "Age classification from facial images", Journal of Computational Vision and Image Understanding, Vol.242.No.2, PP:132-144.

[42] V.Blanz , T.Vetter (1999) , "A morphable model for the synthesis of 3D faces" in Proceedings of SIGGRAPH, 26th Annual Conference on Computer Graphics and Interactive Techniques, PP:187-194.

[43] Henry A.Rowley, Shumeet Baluja, Takeo Kanade (1998), "Neural Network-Based Face Detection", IEEE Transactions on Pattern Analysis and Machine Intelligence, PP:1-27.

[44] Belhumeur, P.N, New Haven, Hespanha, J.P, Kriegman, D (1997), "Eigen faces vs. Fisherfaces: recognition using class specific linear projection", IEEE Transaction on Pattern Analysis and Machine Intelligence, Vol. 19, No. 1, PP : 711-720.

[45] A.J.O.Toole, T.Vetter, H.Volz, M.Salter, (1997), "Three-dimensional carcatures of human heads: Distinctiveness and the perception of facial age", Perception, Vol.26 PP:719-732.

[46] Rama chellappa, Charles L Wilson (1995), "Human and Machine Recognition of Faces : A survey", Proceedings of the IEEE, Vol 83, No 5, PP: 705-739

[47] Y.Wu.N.Thalmann, D.Tahalmann (1995) "A Dynamic winkle model of facial animation and skin aging", Journal of Visualization and Computer Animation, Vol.6, PP:195-205.

[48] Pentlant A, Moghaddam B and Starnel T (1994) " View – based and modular eigenspaces for face recognition", Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition PP: 84-91.

LIST OF PUBLICATIONS BY AUTHORS

International Journals

1. Karthigayani P., and Sridhar S (2013) " Decision Tree Based Occlusion Detection in Face Verification and Estimation of Human Age using Back Propagation Neural Network" , Journal of Computer Science (JCS) , Vol. 10, No. 1, PP : 115-124.
2. Karthigayani P., and Sridhar S (2013), " A Novel Approach for Image Based Occlusion Detection in Face Verification and Estimation of Human age using Back Propagation Neural

Network", International Journal on Advances in Computing and Communication Technologies, Vol. 2, No.1, PP: 244-257.

3. Karthigayani P., and Sridhar S(2013), "Face Recognition using Local Binary Pattern and Discriminative approach", International Journal of Innovative Technology and Research, Vol. 2, No.1, PP: 705-711

4. Karthigayani P., and Sridhar S (2011) " Image Based Occlusion Verification in Face Detection and Age Estimation using AdaBoost and Decision Tree with C5.0 Algorithm using Morph Data set", International Journal on Recent Trends in Engineering and Technology (IJRTET) Vol. 6, No. 1,
PP : 1-4.

5. Karthigayani P., and Sridhar S (2011) "A Novel Approach for Face Verification and Age Estimation using Local Binary Pattern, Elastic Matching Pattern and Back Propagation Neural Network", International Journal of Intelligent Electronic systems (IJIES), Vol. 5 No. 2 PP: 37-46.

National Journals

1. Karthigayani P., and Sridhar S (2013), "Occlusion Verification in Face Detection and Age estimation using Local Binary Pattern and DTOD classifier using Morph Dataset", Indian Journal of Computer Science and Engineering(IJCSE)" Vol. 4, No.1,
PP: 1-10.

2. Karthigayani P., and Sridhar S (2013), "A Novel Approach for Decision Tree Occlusion Detection(DTOD) classifier for Face verification and estimation of age using Back Propagation Neural Network", Journal of Computer Science Engineering and Information Technology Research(JCSEITR) Vol. 3, No. 1
PP: 1-10.

International Conferences

1. Karthigayani P., and Sridhar S (2013), "A Novel Approach for Images Based Occlusion Detection in Face Verification and Estimation of human age using Back Propagation Neural Network", International Multi Conference on Emerging Trends in Computer Science and Information Technology in Kuala Lumpur, Malaysia PP :154-162.

2. Karthigayani P., and Sridhar S (2012), "Occlusion Verification in Face Detection and Age estimation using Local Binary Pattern and DTOD classifier using Morph Dataset", International Convention cum Pre-Conference Workshop on Innovations in Engineering and Technology for Sustainable Development (IETSD), Bannari Amman Institute of Technology and University of Derby PP : 256-262.

3. Karthigayani P., and Sridhar S (2011), " A Novel Approach for Face Recognition using Local Binary Pattern, Discriminative Approach using Two Layered Back Propagation Neural Network", 3rd International Conference on Trendz in Information sciences and computing (TISC), Sathyabama University, Chennai PP : 11-16.

4. Karthigayani P., and Sridhar S (2010), "Machine Vision Using Machine Learning", International Conference on Computational Vision and Robotics (ICCVR), Bhuvaneswar, India, PP: 321-324.

National Conferences

1. Karthigayani P., and Sridhar S (2012), "Occlusion Detection in Face Verification using Decision Tree Algorithm and Discrete Wavelet Transform and Local Binary Pattern with Morph Dataset", 2nd "National Conference on Emerging Trends in Computer Applications (NCETCA)", SRM University, Chennai, PP: 82-94.

2. Karthigayani P., and Sridhar S (2011), "A Novel Approach for Age estimation using Local Binary Pattern, Two layered Back Propagation Neural Network", Current Academic Research in communication and networking (CARCN), Sathyabama University, Chennai, PP:25-34.

3. Karthigayani P., and Sridhar S (2011), "Image Based Age Progression and Estimation using Discriminative approach and Local Binary Pattern using Morph Dataset", in Annual Convention on Geo-spatial Technologies and Applications (Geo Summit 2011) , Sathyabama University, PP: 30.

4. Karthigayani P., and Sridhar S (2010), "Age Estimation using Machine Using and Artificial Neural Networks", National Conference on Emerging Trends in Networking automation and control Technologies (ENACT)" by Sathyabama University association with CSIO and ISA.

