IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

A Method of Partial Face Recognition Using LDA and Back Propagation Neural Network

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Abstract: The face recognition is a classical research domain, a number of research contributions are available by different contributors. Beyond their key contributions the proposed work is aimed to design a new recognition model that can work on incomplete data or information of face to recognize the target person. Additionally the work also indented to find pose recognition too. Both the issues are lead to increase the rate of misclassification or recognition during the face recognition. Thus the proposed work is proposing a LDA and MLP based face recognition to mitigate the issues of face recognition task. The proposed working model including the LDA based feature selection technique. The LDA (Linear Discriminant Analysis) is technique that is also used for dimensionality reduction additionally to compute a common projection in a higher dimensional space. Further the LDA based pose features are trained using the MLP (Multi Layer Perceptron). The MLP is a feed forward neural network and work for optimal classification outcomes. After training the model is tested on a test dataset. The experimental results demonstrate the effective performance in terms of accuracy as well as the method shows less resource consumption in terms of memory and time.

Keywords: MLP, neural network, LDA, face recognition, multi-pose recognition.

I. INTRODUCTION

Now in these days the Machine Learning (ML) and its techniques are played essential role in various real world applications. These applications are used for pattern recognition, classification, categorization, prediction, motion detection and various others [1]. Additionally the ML algorithm also works well with the images, for motion detection, activity recognition and others. Among them the face recognition is one of the most essential applications. That is used in wide range of security, surveillance, monitoring, and authentication based application development [2]. Face is one of the most essential identities, which is almost different and unique for all the individuals. In a number of applications it is used as a biometric identity and utilized for authentication and access control [3]. But these applications are feasible if the recognition of the faces becomes accurate. The low rate of face recognition can degrade the performance of these applications. The basic issues of these systems are the pose variation, partial capturing of faces, small changes on faces, low resolution images, noisy images and others [4].

Due to this the traditional face recognition systems need improvement. The proposed work is intended to design an accurate face recognition technique that works on different variants of faces and can able to recognize pose of user [5]. Therefore ORL dataset is used for designing the face recognition system which learns on different poses of faces to recognize the end user. For this purpose LDA (linear discriminant analysis) technique is employed for features extraction. The multi-pose based features are used with the Multi-Layer Perceptron (MLP) for training. After training of the MLP is able to accept any face pose and can recognize.

II. PROPOSED WORK

The proposed work is motivated to study the multiple pose based face recognition system. In this context the proposed work includes the implementation of a machine learning based technique. This chapter involves the detailed explanation of the proposed model for recognizing face poses accurately.

A. System Overview

Face recognition is one of the frequently growing research area, a number of highly accurate models for recognizing faces in multiple poses are presented in recent years. Among most of the techniques are either less accurate or computationally expensive. Therefore the proposed work is focused on exploring the accurate pose based face recognition model with low resource consumption. Additionally the proposed model is also extended to offer a technique for partial face recognition. Because most of the models are not able to recognize the partial faces or lost information. Thus we are proposing a solution for two limitations of the current approaches:

1. **Recognition of partial faces:** sometimes due to lighting effect and other conditions the incomplete information is captured by the sensors or image capturing device. Thus

recognition results are affected, thus in this context the proposed work is focused on recognizing the faces and poses with limited or partial information.

2. **Recognition of face after small change in face images (i.e. smiling face, crying face):** the small change in face can change the look of entire face. Thus recognition becomes complex and hard to recognize the actual person. Therefore the proposed work is motivated to enhance the existing technique to improve the learning for pose based changes in the face image.

Basically, even small changes in face can impact on the performance of the learning algorithm for face recognition. Therefore need to be developing a feature selection and classification method by which we achieve the required consequences. In this section the basic requirement of the system is demonstrated and the next section involves the required methodology of the proposed system.

B. Proposed Methodology

The required multi-pose face recognition model is demonstrated in figure 2.1. Additionally the connected components of the model are also discussed. The proposed model can be understood using two modules i.e. training and testing.

Multi-pose dataset: the supervised machine learning algorithms requires some training samples to learn on the pattern. Thus ORL face dataset is used for model training and testing. This dataset consist of 40 classes or identities. Additionally each class has 10 different poses. Means total of 400 images of 40 people face images are used. This data is further being used for training and testing of the proposed model.

Partial face conversion: in this work we need to train the system with the help of multi-pose as well as the partial faces. Thus the classical ORL dataset is transformed to get partial face images. Therefore a single image is transformed into four partial faces. First two faces using vertical partitioning is created and next two faces by horizontal partitioning is created.

LDA feature extraction: Linear Discriminant Analysis (LDA) is a dimensionality reduction technique. It is used as a pre-processing step in Machine Learning applications of pattern classification. The goal of LDA is to project the features in higher dimensional space in order to avoid the curse of dimensionality and to reduce resources cost. The technique was developed by Ronald A. Fisher and named Linear Discriminant or Fisher's Discriminant Analysis.

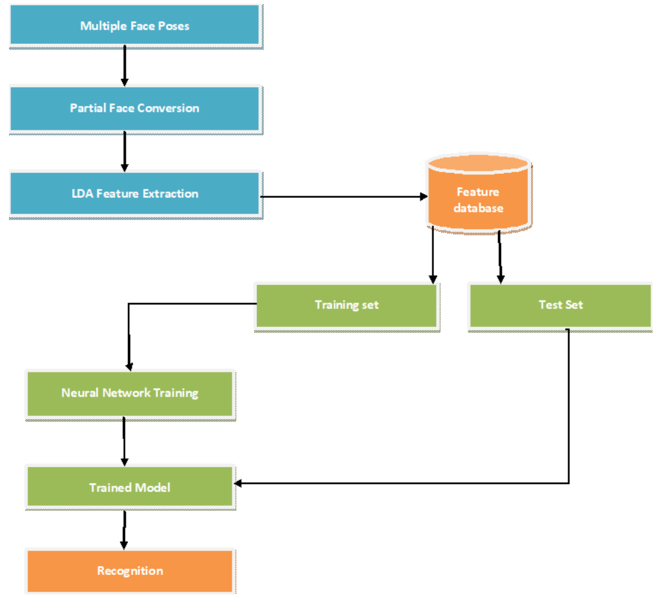

Figure 2.1 proposed model

This category of dimensionality reduction is used in image recognition and predictive analysis. LDA focuses on projecting the features in higher dimension space to lower dimensions in three steps:

- First, need to calculate the separability between classes which is the distance between the mean of different classes. This is called the between-class variance.

$$S_b = \sum_{i=1}^{g} N_i(\overline{x}_i - \overline{x})(\overline{x}_i - \overline{x})^T$$

- Second, calculate the distance between the mean and sample of each class. It is also called the within-class variance.

$$S_w = \sum_{i=1}^{g} (N_i - 1)S_i$$

$$S_w = \sum_{i=1}^{N} \sum_{j=1}^{N} (\overline{x_{i,j}} - \overline{x}_i)(\overline{x_{i,j}} - \overline{x}_i)^T$$

- Finally, construct the lower-dimensional space which maximizes the between-class variance and minimizes the within-class variance. P is considered as the lower-dimensional space projection, also called Fisher's criterion.

$$P_{lda} = \arg_P max \frac{|P^T S_b P|}{|P^T S_w P|}$$

Feature database: the process of LDA returns a 2D vector for classification. The calculated feature vectors for all the created poses and sub faces are used with the LDA and for each sub faces features are extracted.

Training and Test Set: the feature storage is used for training and testing of the neural network. Thus among 70% of randomly selected images are used to train the model and 30% of data is used for testing. The system accepts the input sample images and for partial pose recognition the images are partitioned. These partitioned dataset is used with the LDA algorithm to calculate the features the features are further used for training and testing of the system.

Neural network training: The stored image features in database are learned by the artificial neural network (ANN). Here, MLP (Multi-Layer Perceptron) is used for training with the features. An example of Single Layer Perceptron is given in figure 2.2. The Perceptron has just multiply with weights and add Bias, but does this in one layer only. We update the weight when an error in classification or miss-classified results found. Weight update equation is:

$$weight = weight + learning\ rate * (expected - predicted) * x$$

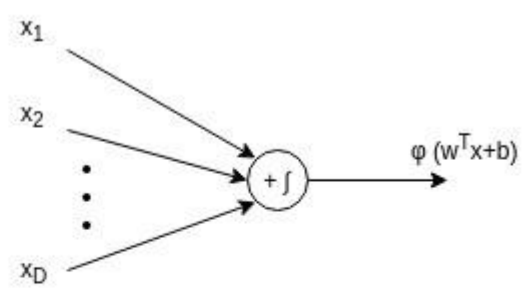

Figure 2.2 single layer Perceptron

In the Multilayer Perceptron, more than one linear layer present. If we take an example of the three-layer network, first layer will be the input layer and last will be output layer and middle layer will be called hidden layer. We feed our input data into the input layer and take the output from the output layer. We can increase the number of the hidden layer as much as we want, to make the model more complex according to application.

Feed Forward Network, is the most typical neural network model. Its goal is to approximate some function $f()$. Given, for example, a classifier $y = f(x)$ that maps an input x to an output class y, the MLP find the best classifier by defining a mapping, $y = f(x; \theta)$ and learning the best parameters θ. The MLP are composed of many functions that are chained together. A network with three layers would form $f(x) = f(3)(f(2)(f(1)(x)))$. Each layer is composed of units that perform an affine transformation of a linear sum of inputs.

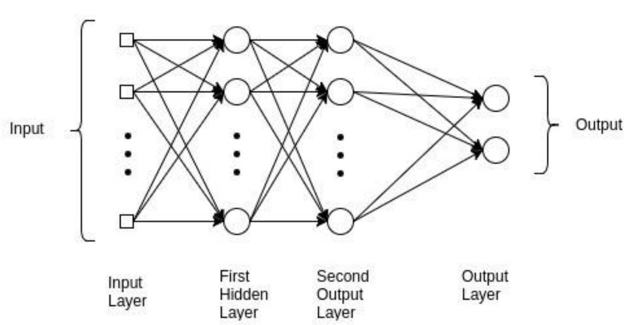

Figure 2.3 Example of MLP

Each layer is represented as $y = f(W^T x + b)$. Where f is the activation function, W is the set of weights, in the layer, x is the input vector, which can also be the output of the previous layer, and b is the bias vector. The layer of an MLP consists of several fully connected layers because each unit in a layer is connected to all the units in the previous layer. In a fully connected layer, the parameters of each unit are independent of the rest of the units in the layer that means each unit posses a unique set of weights.

In a supervised system, each input vector is associated with a label, defining its class with the data. The output of the network gives a class score, for each input. To measure the performance, the loss function is defined. The loss will be high if the predicted class does not correspond to the true class. Sometimes the problem of over-fitting and under-fitting occurs in this case, model performs very well on training data but not on testing data. To train the network, an optimization procedure is required for this we need loss function and an optimizer. This procedure will find the values for the set of weights, W that minimizes the loss function. A popular strategy is to initialize the weights to random values and refine them iteratively to get a lower loss. This refinement is achieved by moving on the direction defined by the gradient of the loss function.

Trained model: after tuning of the MLP parameters the MLP is trained on the patterns. The trained MLP is now able to accept the test dataset and produce the classification outcomes.

Recognition: in this model the provision is made to provide input an individual image for recognition too. After learning the ANN is able to classify the data or faces by producing the test image samples. Finally based on the classification outcomes the performance of the model is computed. The proposed partial face recognition model is used in various other tasks also using multi-pose face recognition technique.

1. Biometric identity based authentication system
2. Identification of faces even some changes on face are found

C. Proposed Algorithm

This section provides the summary of the above discussed methodology for identifying the partial face and pose information. The required steps are explained in table 2.1.

Table 2.1 Proposed Algorithm

Input: Input ORL Dataset D Output: classified outcomes C
Process: 1. $D_n = readDataset(D)$ 2. $D^V_{n*2} = CreateVerticalFace(D_n)$ 3. $D^H_{n*2} = CreateHorizentalFace(D_n)$ 4. $D_m = D^H_{n*2} + D^V_{n*2}$ 5. $[D_{train}, D_{test}] = Split(D_m)$ 6. $for(i = 1; i < D_{train}.length; i++)$ a. $T_{model} = MLP.Train(D_i)$ 7. $end\ for$ 8. $C = T_{model}.Classify(D_{test})$ 9. $return\ C$

III. RESULTS ANALYSIS

This chapter includes the analysis and performance of the results of the implemented algorithms which are used for Multi-Pose Face recognition System. Therefore a detailed discussion about the results and their measured parameters are reported.

A. Accuracy

The accuracy can be explained as the measurement of algorithm classification correctness. That can be measured using the ratio of total correctly classified and the total patterns to be classified. That can also be represented using the following equation:

$$accuracy = \frac{total\ correctly\ classified}{total\ patterns\ to\ classify} X100$$

Table 3.1 Accuracy(%)

Number of face images	Multilayer Perceptron Classifier
40	90.1
160	91.8
320	92.7
600	93.6
900	95.8
1200	96.1
1600	98.3

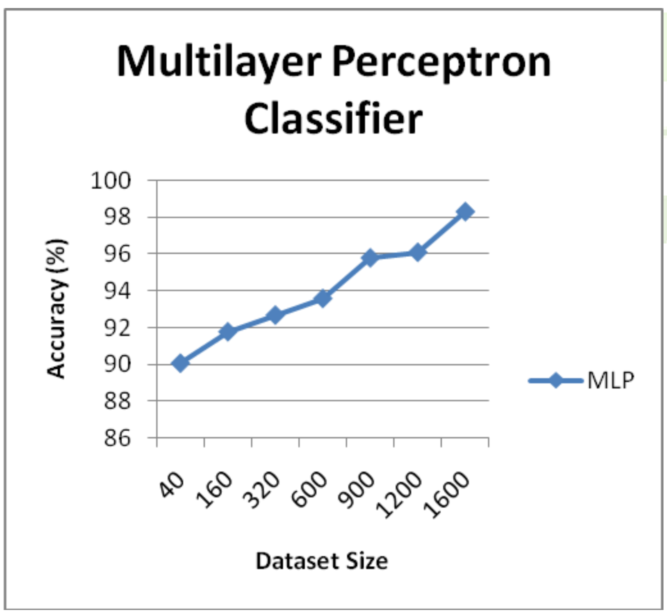

Figure 3.1 Accuracy (%)

The accuracy of pose recognition using MLP based technique is demonstrated in Figure 3.1 and table 3.1. That line graph shows the accuracy of the algorithms in percentage (%). The X-axis of this line graph shows the data instances used during the experiment and Y-axis shows the accuracy of model. According to the obtained performance the proposed model improve their accuracy with the increasing amount of data samples.

B. Error Rate

The error rate of an algorithm demonstrates the misclassification rate of the algorithm as a performance parameter. That can be calculated using the following equation:

$$Error\ Rate = 100 - Accuracy$$

Or

$$Error\ rate = \frac{total\ misclassified\ samples}{total\ samples\ to\ classify} X100$$

Table 3.2 Error rate (%)

Number of Faces	Multilayer Perceptron classifier
40	9.9
160	8.2
320	7.3
600	6.4
900	4.2
1200	3.9
1600	1.7

Reducing error rate is a good indicator of learning algorithm. The algorithm demonstrates the reducing error rate with increasing amount of data. The line graph for the performance of the system is given in figure 3.2 and the observation values are reported in table 3.2. The X axis of the diagram shows the experimental data instances and Y axis shows the percentage error rate produced. According to the explained results the error rate of the algorithm decreases with the amount of data for learning increases.

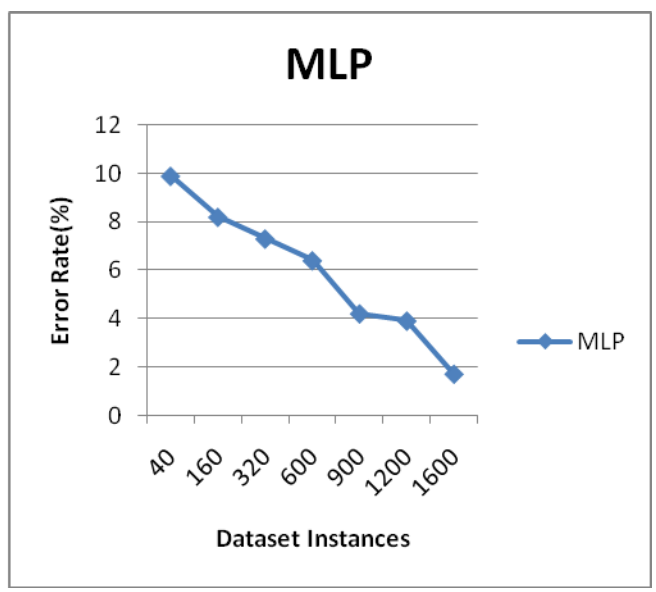

Figure 3.2 Error Rate

C. Memory Usage

The memory usages are also an essential parameter for performance evaluation of a ML algorithm. The amount of total memory utilized for an algorithm is measured here as memory consumption or usages. The memory usages are computed using the following equation.

$$memory\ usage = total\ memory - free\ memory$$

Table 3.3 Memory Usages in KB

Number of faces	Multilayer Perceptron Classifier
40	11228
160	11356
320	12364
600	12987
900	13214
1200	14496
1600	14966

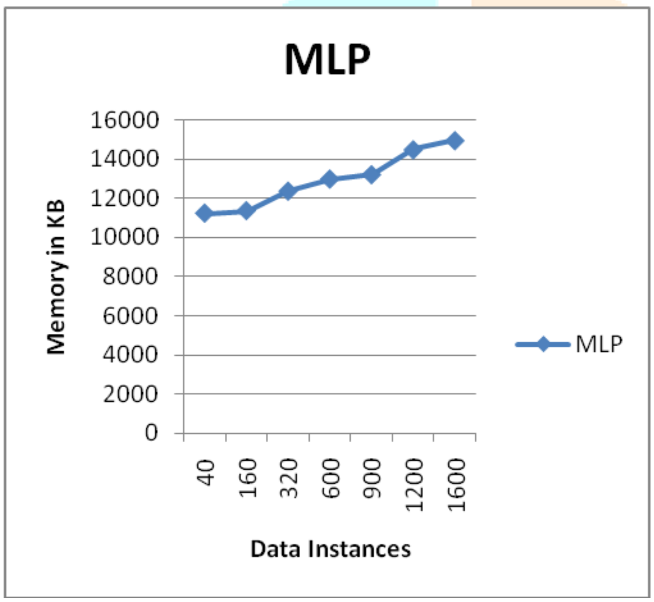

Figure 3.3: Memory Usage

Memory usages are the indicator of system efficiency. The measured memory usages for the model are demonstrated in figure 3.3. It is measured here in terms of KB (kilobytes). To demonstrate the performance line graph 3.3 displays the values of table 3.3. Here the X-axis shows the number of data instances used for experiments and Y-axis shows the used memory. According to the obtained model performance the proposed system demonstrate acceptable amount of memory utilization.

D. Time Consumption

The time consumption is also termed as the time complexity. The amount of time consumed for classification is also calculated in this section using the following formula:

$$time\ consumed = end\ time - start\ time$$

Table 3.4 Time consumed in MS

Number of faces	Multilayer Perceptron Classifier
40	28
160	32
320	97
600	148
900	169
1200	181
1600	205

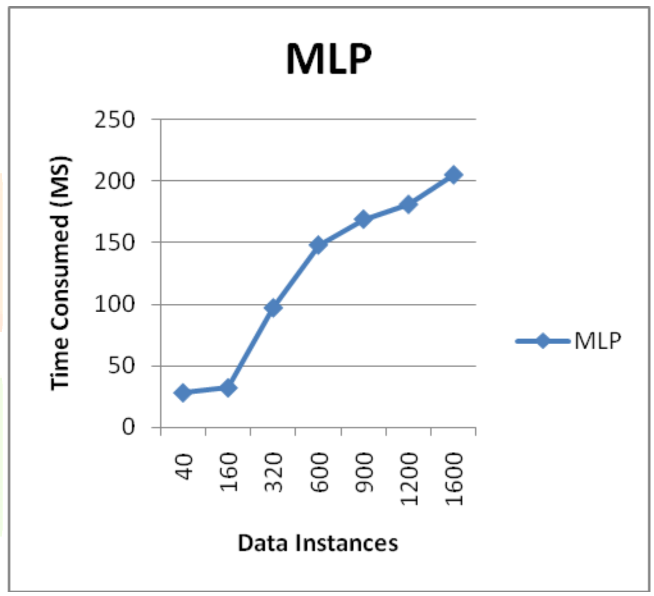

Figure 3.4 Time Consumption

The time consumption of the proposed multi-pose Face Recognition System using Multilayer Perceptron Classifier is explained in the figure 3.4 and table 3.4. It is a line graph for demonstrating the time requirements of algorithms in terms of milliseconds (MS). The X- axis of this line graph shows the data instances used during the experiment and Y- axis shows the time consumption. According to the simulated results the time is increasing with the proportion of the data size increases.

IV. CONCLUSION & FUTURE WORK

The main aim of the proposed work is accomplished successfully the observed facts and experimental outcomes are summarized in this section as conclusion of the work. Additionally the future extension of the work is also reported.

A. Conclusion

The machine learning and similar techniques are growing two help the human being in different professional ways as well as in other real world solutions. The acceptance of this technology is increasing day by day. The proposed work is an investigation of face recognition application using the machine learning technique. Therefore two key problems are targeted to develop an efficient and accurate solution. The first issue is the changes in face due to smile or other effects, and second is to recognize the person using partial face information. Thus the method is not only useful for accurate multi-pose face recognition; it is also useful for image forensics for recognizing the faces with limited information.

Thus a multi-pose face recognition system is designed and implemented in this work. In this context the ORL face database is used for experimentation. The ORL dataset is further partitioned for preparing the actually required training data samples. Thus an image is subdivided into four parts two for horizontal and two for vertical partitioned. These training images are further utilized with the LDA feature selection technique. The LDA is self a classifier but it is used here as the feature extraction dimension reduction technique. The extracted features from the training samples are used with the MLP (Multi-Layer Perceptron). The learnt neural network is further utilizes the test dataset to classify the face poses and produce the performance outcomes. The implementation of the proposed system is carried out using JAVA technology. Additionally to store the observed performance MySql server is used. The performance of the implemented system is evaluated in terms of different parameters which are reported in table 4.1 as performance summary:

Table 4.1 performance summary

S. No.	Parameters	Remark
1	Accuracy	The accuracy of the proposed MLP based face recognition system is effective and improving the increasing size of learning samples
2	Error rate	The error rate also improves with the size of learning data. Thus the proposed work produces acceptable error rate less then 10%.
3	Memory usage	The memory efficient system is implemented with LDA which initially reduces the size of images for learning process
4	Time consumed	Time is similar in ratio as the amount of learning samples are produced for input

According to the performance the proposed algorithm demonstrate efficient working as well as accurate recognition. Thus it is acceptable for the future application development.

B. Future Work

The conclusion of the work demonstrates the proposed work is effective and accurate for identifying the partial face information. This model can be used in various other applications. Therefore that technique is further extended for the following aspects:

1. Improving the technique for finding livens of person
2. Improve this technique using deep CNN architecture

REFERENCES

[1] Bhamare, P. Suryawanshi, "Review on Reliable Pattern Recognition with Machine Learning Techniques", Fuzzy Information and Engineering, 10:3, 362-377

[2] F. P. Mahdia, Md. M. Habibb, Md. A. R. Ahadb, S. Mckeeverc, A. S. M. Moslehuddinb, P. Vasanta, "Face recognition-based real-time system for surveillance", Intelligent Decision Technologies 11 (2017) 79–92

[3] A. K. Jain, S. Pankanti, S. Prabhakar, L. Hong, A. Ross, J. L. Wayman, "Biometrics: A Grand Challenge", Proceedings of International Conference on Pattern Recognition, Cambridge, UK, Aug. 2004

[4] M. Hassaballah, S. Aly, "Face recognition: challenges, achievements and future directions", IET Comput. Vis., 2015, Vol. 9, Iss. 4, pp. 614–626, 614 & The Institution of Engineering and Technology 2015

[5] M. P. Beham, S. M. M. Roomi, "A Review of Face Recognition Methods", International Journal of Pattern Recognition and Artificial Intelligence Vol. 27, No. 4 (2013) 1356005 (35 pages)

[6] X. Yin, X. Liu, "Multi-Task Convolutional Neural Network for Pose-Invariant Face Recognition", arXiv:1702.04710v2 [cs.CV] 9 May 2017

[7] Zdeneˇk Rˇ íha and Václav Matyáš, "Biometric Authentication Systems", Faculty of Informatics , Masaryk University, FI MU Report Series, November 2000.

[8] Bichlien Hoang and Ashley Caudill, "Biometrics", available online at: https://www.ieee.org/about/technologies/emerging/biometrics.pdf

[9] "Biometrics Overview", National Science and Technology Council, available online: http://www.biometricscatalog.org/NSTCSubcommittee/Documents/Biometrics%20Overview.pdf

[10] Bradski, G. and Kaehler, A. 2008, Learning OpenCV: Computer Vision with the OpenCV Library. Sebastopol: O'Reilly.

[11] Roble, D. (1999). Vision in film and special effects, Computer Graphics, 33(4):58–60.

[12] Roble, D. and Zafar, N. B. (2009). Don't trust your eyes: cutting-edge visual effects. Computer, 42(7):35–41.

[13] Chuang, Y.-Y., Agarwala, A., Curless, B., Salesin, D. H., and Szeliski, R., Video matting of complex scenes, ACM Transactions on Graphics (Proc. SIGGRAPH 2002), 21(3):243–248.

[14] R. Szeliski, "Computer Vision: Algorithms and Applications", September 3, 2010 draft 2010 Springer.

[15] S. Kumar, H. Kaur, "Face Recognition Techniques: Classification and Comparisons", International Journal of Information Technology and Knowledge Management July-December 2012, Volume 5, No. 2, pp. 361-363

[16] R. M. Ramadan, R. F. A. Kader, "Face Recognition Using Particle Swarm Optimization-Based Selected Features", International Journal of Signal Processing, Image Processing and Pattern Recognition, Volume 2, No. 2, June 2009.

[17] V. Vijayakumari, "Face Recognition Techniques: A Survey", World Journal of Computer Application and Technology 1(2): 41-50, 2013.

[18] R. Brunelli, T. Poggio, "Face Recognition: Features versus Templates," IEEE Trans. Pattern Analysis and Machine Intelligence, Volume 15, Number 10, PP. 1042-1052, 1993.

[19] A. K. Jain, R. Bolle, and S. Pankanti, "Biometrics: Personal Identification in Networked Security", Eds.: Kluwer Academic Publishers, 1999.

[20] K. Kim, "Intelligent Immigration Control System by Using Passport Recognition and Face Verification," in International Symposium on Neural Networks.

[21] M. B. Holte, C. Tran, "Human Pose Estimation and Activity Recognition From Multi-View Videos: Comparative Explorations of Recent Developments", IEEE Journal Of

Selected Topics in Signal Processing, VOL. 6, NO. 5, September 2012.

[22] R. Chellappa, C. L. Wilson, S. Sirohey, Human and Machine Recognition of Faces: A Survey. Proceedings of the IEEE, 83(5):705–740, May 1995.

[23] Andrew W. Senior, "Face and Feature Finding for a Face Recognition System", In 2nd International Conference on Audio- and Video-based Biometric Person Authentication, PP 154 –159, March 1999.

[24] B. Maison, C. Neti, and A. Senior, Audio-visual Speaker Recognition for Video Broadcast News: Some Fusion Techniques, In Multi-media Signal Processing, 1999.

[25] P. I. Wilson, J. Fernandez, "Facial feature detection using Haar classifiers." Journal of Computing Sciences in Colleges 21.4 (2006): 127-133.

[26] A. Scheenstra, A. Ruifrok, R. C. Veltkamp, "A survey of 3D face recognition methods", Audio-and Video-Based Biometric Person Authentication, Springer Berlin Heidelberg, (2005).

[27] K. Kim, "Intelligent Immigration Control System by Using Passport Recognition and Face Verification," in International Symposium on Neural Network.

[28] "CNN: Education School face scanner to search for sex offenders." Phoenix, Arizona: The Associated Press, 2003.

[29] P. J. Phillips, H. Moon, P. J. Rauss, and S. A. Rizvi, "The FERET Evaluation Methodology for Face Recognition Algorithms," IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume 22, PP.1090-1104, 2000

[30] T. Choudhry, B. Clarkson, T. Jebara, and A. Pentland, "Multimodal person recognition using unconstrained audio and video," in Proceedings, International Conference on Audio and Video-Based Person Authentication, PP.176-181, 1999,

[31] Brimblecombe, Phil. "Face Detection using Neural Networks" H615–Meng Electronic Engineering, School of Electronics and Physical Sciences, URN 1046063 (2002).

[32] E. Hjelmas, B. K. Low, "Face Detection: A Survey," Computer Vision and Image Understanding, 83, 236-274 April 2001.

[33] T. Sakai, M. Nagao, T. Kanade, "Computer analysis and classification of photographs of human face", First USA Japan Computer Conference, 1972

[34] S. A Patil, Dr. P. J. Deore, "Face Recognition: A Survey", Informatics Engineering, an International Journal (IEIJ), Vol.1, No.1, PP. 31 - 41 December 2013

[35] M. Savvides, J. Heo, S. W. Park, "Face recognition", In Anil K, Jain, Patrick Flynn, and Arun A. Ross, editors, Handbook of Biometrics, pages 43-70, Springer US, 2008.

[36] N. Kaur, R. Jakhar, R. Singh, Face recognition using bacteria foraging optimization-based selected features, (IJACSA), International Journal of Advanced Computer Science and Applications, Special Issue on Artificial Intelligence 2011.

[37] M. Turk and A. Pentland, "Eigenfaces for Recognition", Volume 3, Issue 1, PP. 71 - 86, January 1991

[38] W.J. Krzanowski, P. Jonathan, W.V McCarthy, and M.R. Thomas, "Discriminate Analysis with Singular Covariance Matrices: Methods and Applications to Spectroscopic Data", Applied Statistics, Volume 44, PP. 101-115, 1995.

[39] R. M. Ramadan, R. F. Abdel, "Face Recognition Using Particle Swarm Optimization-Based Selected Features", 2009.

[40] L. Cervante, B. Xue, M. Zhang," Binary Particle Swarm Optimization for Feature Selection: A Filter Based Approach", WCCI 2012 IEEE World Congress on Computational Intelligence June, PP. 10-15, 2012 - Brisbane, Australia.

[41] Y. Wang, C. Wang, L. Liang, "Sparse representation theory sand its application for face recognition", International Journal on Smart Sensing & Intelligent Systems 8.1 (2015).

[42] S. S. Farfade, M. Saberian, L. J. Li, "Multi-view Face Detection Using Deep Convolutional Neural Networks", ICMR'15, June 23–26, 2015, Shanghai, China Copyright is held by the owner/author(s). ACM 978-1-4503-3274-3/15/06

[43] P. Tzirakis, G. Trigeorgis, M. A. Nicolaou, B. Schuller, S. Zafeiriou, "End-to-End Multimodal Emotion Recognition using Deep Neural Networks", Journal of Latex Class Files, Vol. 14, No. 8, Aug 2015

[44] W. Hu, Y. Huang, L. Wei, F. Zhang, H. Li, "Deep Convolutional Neural Networks for Hyperspectral Image Classification", Hindawi Publishing Corporation Journal of Sensors Volume 2015, Article ID 258619, 12 pages

[45] Z. Yu, C. Zhang, "Image based Static Facial Expression Recognition with Multiple Deep Network Learning", ICMI 2015, November 9–13, 2015, Seattle, WA, USA c 2015 ACM ISBN 978-1-4503-3912-4/15/11

[46] X. Yin, X. Liu, "Multi-Task Convolutional Neural Network for Pose-Invariant Face Recognition", arXiv:1702.04710v2 [cs.CV] 9 May 2017

[47] P. M. Kumar, U. Gandhi, R. Varatharajan, G. Manogaran, R. Jidhesh, T. Vadive1, "Intelligent face recognition and navigation system using neural learning for smart security in Internet of Things", Springer Science+Business Media, LLC, part of Springer Nature 2017

[48] M. A. Abuzneid, A. Mahmood, "Enhanced Human Face Recognition Using LBPH Descriptor, Multi-KNN, and Back-Propagation Neural Network", 2169-3536, 2018 IEEE, Vol 6, 2018

[49] Z. Wu, M. Peng, T. Chen, "Thermal Face Recognition Using Convolutional Neural Network", 2016 International Conference on Optoelectronics and Image Processing, 978-1-5090-0880-3/16/$31.00 ©2016 IEEE

[50] S. Kumaar, R. M. Vishwanath, S. N. Omkar, A. Majeedi, A. Dogra, "Disguised Facial Recognition Using Neural Networks", 2018 IEEE 3rd International Conference on Signal and Image Processing, 978-1-5386-6396-7/18/$31.00 ©2018 IEEE

[51] M. F. Hansen, M. L. Smith, L. N. Smith, M. G. Salter, E. M. Baxter, M. Farish, B. Grieved, "Towards on-farm pig face recognition using convolutional neural networks", Computers in Industry, 2018, 98, 145-152EE

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