International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

# Design of Efficient Pipeline Framework for Xml-Based Classifier Using Data Engineering Techniques

**Nilesh D. Navghare[1,2], L. Mary Gladence [3]**

**Submitted**: 23/12/2023 **Revised**: 29/01/2024 **Accepted**: 07/02/2024

**Abstract**: In the field of modern era designing efficient framework for real time face detection systems stand out as innovative and technologically advanced solutions. This article describes the development and implementation of a system that leverages face detection model to accurately and efficiently identify objects in a variety of environments, including educational institutions, corporate environments, criminal detection and events. The xml-based face detection framework uses state-of-the-art using normal classification learning algorithms to analyze and recognize facial features, ensuring a high level of person identification accuracy. The framework can be seamlessly integrated into existing infrastructure, enabling an optimized and discreet monitoring of the image recording process. Additionally, the system is designed with user privacy and data security in mind, incorporating encryption and robust authentication mechanisms. Key features of the face detection system include real-time object detection, automatic data recording, and comprehensive reporting. The system's user-friendly interface allows for easy integration into various organizational structures, making it a versatile solution for time and for checking the identity of various objects.

***Keywords:*** *Face detection, Haar-cascade, OpenCV, LBPH, Image Processing*

## 1. Introduction

Traditional process for humans to identify a face, vision-based automated systems find it difficult to do so. Numerous academic fields, including computer vision, anthropometry, pattern identification, neural networks, statistics, and image processing, have been actively researching this topic. Facial detection and identification can be used by vision-based automated systems in a extensive range of commercial applications, including games, multimedia entertainment, surveillance, biometric authentication, and human-computer interaction [1].

Automation has grown to be a crucial aspect of daily living these days. In the case of monitoring, it becomes extremely vital because human intervention is prone to inaccuracy. When combined, Python and OpenCV offer incredibly potent tools for processing images and videos. This study uses OpenCV and Python to illustrate the value of automation in surveillance systems. It attempts to recognize people by creating an XML classifier known as the harr cascade file, which is a fairly straightforward and effective tool if properly trained and tested [2].

Face detection is a very reasonable biometric since it is non-invasive and does not require the user to make physical contact with the device, in contrast to other biometrics. The four stages of vision-based automated face detection systems are feature extraction, matching, picture pre-processing, and face detection. Since faces belong to a comparable class of objects and share geometrical traits like mouths, noses, chins, and eyes, face detection is a challenging process. The facial image that was taken can be pre-processed in order to compensate for changes in lighting .The process of creating a geometrical or vector model and extracting its key attributes is known as feature extraction [3].

[1]*School of Computing, Sathyabama Institute of Science and Technology, Jeppiaar Nagar, Chennai.*
[2]*School of Computer Engineering, MIT Academy of Engineering, Alandi, Pune - 412105, India*
[3]*School of Computing, Sathyabama Institute of Science and Technology, Jeppiaar Nagar, Chennai.*
[1]*nileshnavghare93@gmail.com,* [2]*nilesh.navghare@mitaoe.ac.in,* [3]*marygladence.it@sathyabama,ac.in*

## 2. Motivation

The motivation to introduce facial detection systems from the need to overcome several challenges associated with traditional object tracking methods. The main reasons for adopting such systems are accuracy and reliability. Facial recognition technology provides a highly accurate and reliable method of real time object management. Unlike manual methods or card-based systems, facial recognition minimizes the risk of errors and ensures the accuracy of time and object detection.

## 3. Related Work

S.Suresh and K.R.Venugopal investigated various facial recognition techniques used in automate real time bject detecton systems. This work discusses challenges related to the effects of different lighting conditions, facial expressions, and different datasets [4].

The proposed study examines the legal and ethical aspects of facial recognition technology. Focused and addressing global issues. Topic Policy and Practice. discuss pri- vacy concerns, implicit bias, and the need for regulations governing the use of facial recognition in the public and private sectors [5].

The proposed research article describes a practical implementation of an automated time and face recognition system using facial recognition. This work describes the system architecture, hardware components, and facial recognition algorithm integration. This system describes the system architecture, hardware components, and facial recognition algorithm integration. This study evaluates the performance of the system in a real-world scenario [6].

M.J.M.Nor et al. provides an overview of facial recognition technology, including traditional methods and recent advances. Proposed system discusses challenges related to variations in pose, lighting, and facial expressions. This paper provides valuable insights for researchers developing robust systems for facial recognition [7].

R.Singh et al. proposed a framework for face recognition that considers real-time processing and accuracy. The integration of hardware components and highlight the importance of feature extraction methods. This study contributes to the practical implementation aspects of facial recognition systems. The proposed system also demonstrates how face recognition is used to take for real time object detection. Nowadays due to advancement in biometric systems this technique gets significant momentum[8]

## 4. Methodology

### 4.1 Collection of Images

A positive image of the object can be detected (in this case the face image) must be collected at a resolution of 300*300 to 400*400.

Since the positive image is transferred to the negative image during pattern creation, the resolution of the positive image was kept lower than that of the negative image. Thirty positive images were used and saved in the raw data directory. This system made sure that the object you want to capture an image (positive image) of is covered in all directions and in all cases. When considering facial recognition, collected images that looked like faces placed in front of a camera [9][10].

### 4.2 Proposed Approach

Database Creation: Create a database to store facial features and corresponding user information. Capture and store different facial images for each user to improve system accuracy.

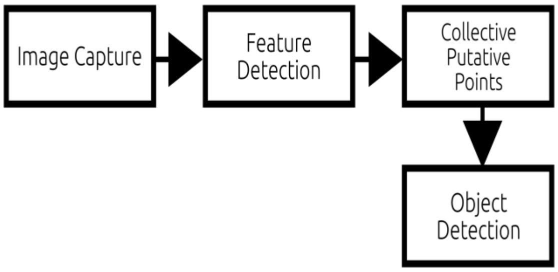


**Fig. 1.** Block diagram for Proposed System

The above depicted figure 1 is showing overall system architecture for object detection. Firstly real time object is taken as an input then it is converted into gray scale image after that feature extraction is initiated. Once feature extraction is done the training process starts and object detection is conducted through real time surveillance. Finally the object tracking is performed and if there is match between object which is detected and the object which is tracked then final tracked object is stored in database along with ID, Name, Date and time.

## 5. Implementation

### 5.1 System Implementation

Now you'll learn how to create your own hair cascade files. Using a single positive image, you can actually create a series of positive examples using negative images using the open cv create Examples command. Your positive image overlaps with these negative images, becomes distorted, and all sorts of things. It actually works quite well, especially if you're just looking for a specific face. Keep it simple and use only one positive image and create a series of patterns with negative images.

### 5.2 User Interface

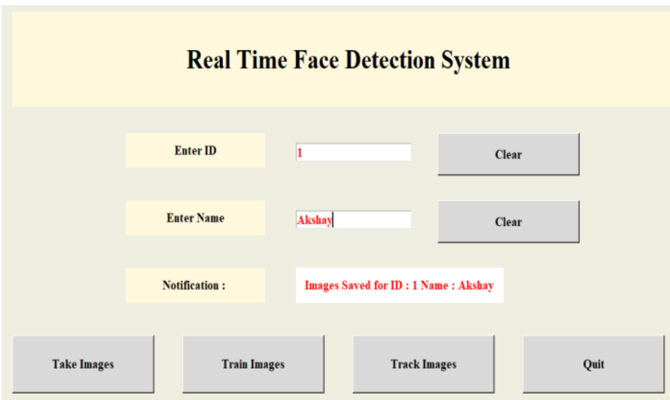


**Fig. 2.** GUI of Proposed Object Detection system

OpenCV comes with a trainer and detector. If you want to train your own classifier for objects such as face,cars or airplanes, you can create a classifier using OpenCV. You are concerned with face detection here. First, you need to load the required XML classifier.

Next, load the input image (or video) in grayscale mode. Now, find the face in the real time scene. If face is found, the location of the detected object is returned as Rect(x, y, w, h). Once these positions are determined, you can create her ROI (Region of Interest) for the face object.

### 5.3 Data Description

Cascading is typically done through cost-conscious ADA boost. The perceptual threshold (0.8 in this figure) can be adjusted so that there are approximately 100 real defects() and some false defects. You can also start the stage 2 process again until the required computation time is reached. Each stage of the classifier cannot have a detection rate (recognition rate) lower than the desired rate, making it a constrained optimization problem. More specifically, global perception becomes a product of stage perception. A cascade classifier is available in OpenCV and is pre-trained on frontal and torso. Training new algorithms in OpenCV can also be done using Haar training or training cascade styles. This can be used for rapid object detection of other specific targets, such as non-human objects with hair-like features.

This process requires two sets of negative and positive samples. Negative samples correspond to any non-object images. Time constraints when training classifiers can be overcome using Pall computing style

Selecting a facial detection algorithm: Select the appropriate facial detection algorithm based on your project requirements and environment. Consider deep learning frameworks like TensorFlow and OpenCV for robust feature extraction and matching.

**Data Preprocessing:** Preprocess facial images to improve quality and reduce variations caused by factors such as lighting conditions and facial expressions. Normalize images for consistent feature extraction.

**Model Training:** Train a face recognition model using a labelled dataset with positive and negative examples.

Algorithm Eigen surface: Based on Principal Component Analysis (PCA).Represents a face as a linear combination of a set of base images Fisher- face similar to Eigen faces, but uses Fisher's linear discriminant to improve identification.

**Haar Cascade:** This algorithm is not very complex and can be executed in real time. You can train the Haar cascade detector to detect different objects such as face, cars, bikes, buildings, and fruits. Haar Cascade uses cascading windows, computes the features of each window, and attempts to classify whether it is a possible object or not.

### 5.4 Functional Implementation

Install the required libraries using the following command: Important note: Replace "sample-image.jpg" with the path to your sample image. Replace 'known-face- descriptor' with a descriptor of a known person (usually there is a database of known faces and descriptors).You need to download the shape prediction and facial recognition model files from the dlib website: http: //dlib.net/files/ Run the script: This script uses OpenCV Provides a basic understanding of facial recognition and dlib.

A real time object detection system would extend this script to manipulate camera feeds, maintain a database of known faces, and integrate with object tracking logic.

## 5. Result and Discussion

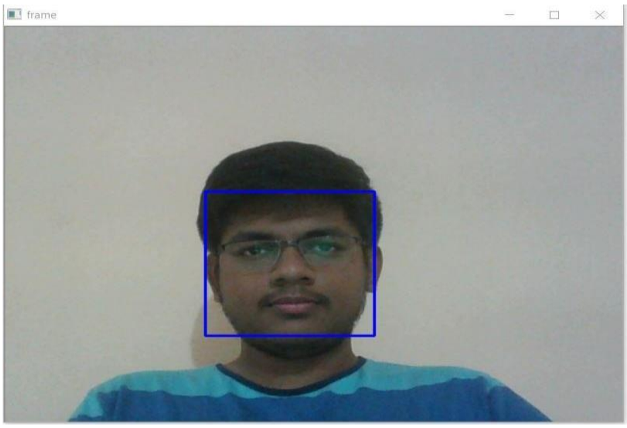


**Fig 3.** Detection of face

The training of the face detection Harr cascade XML classifier is shown in the above table. The above mention pertains to the experimental readings. We have successfully developed the Harr cascade XML classifier up to the ninth step in this experiment. It is evident from the reading above that pre calculation time stays constant while background processing time increases exponentially with increasing training levels for the Harr cascade file. Training time gradually increases at this point. Here, the precalculation time fluctuates between 6.5 and 7.6 ms, indicating that it is almost constant within that range.

**Fig 4.** Storing of images in dataset of user 1

**Table 1:** Results of Response Processing Time of Model

| Level No | Background processing time (ms) | Precalculation time (ms) | Model training time (ms) |
|---|---|---|---|
| 0 | 0.01 | 7.43 | 2.96 |
| 1 | 0.03 | 7.03 | 2.83 |
| 2 | 0.07 | 6.65 | 2.72 |
| 3 | 0.1 | 6.61 | 3.09 |
| 4 | 0.43 | 6.99 | 3.27 |
| 5 | 0.83 | 6.92 | 3.69 |
| 6 | 1.48 | 6.74 | 4.73 |
| 7 | 7.84 | 6.93 | 5.72 |
| 8 | 27.05 | 6.44 | 8.83 |

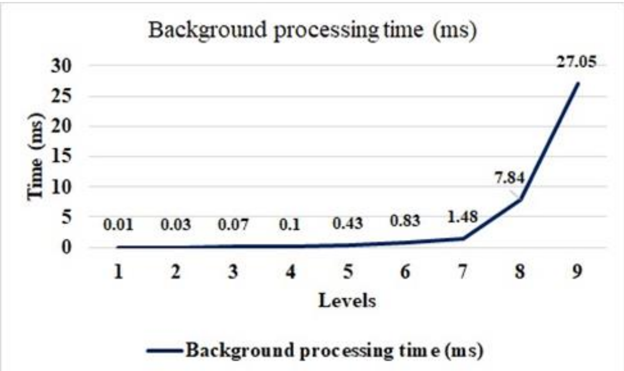


**Fig 5.** Background Processing Time

In the above depicted figure 5 as the number of levels increases there is increase in background processing time. So in this figure it is observed that there is directly proportional relation between levels and background processing time.

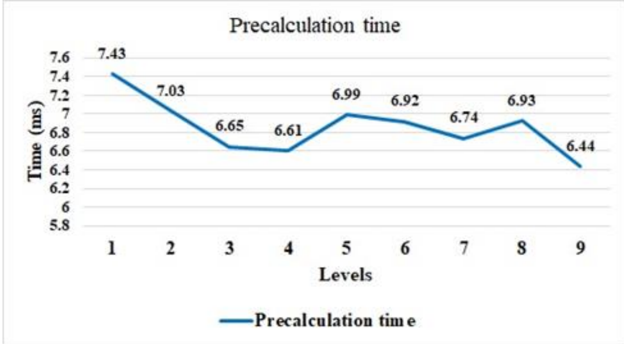


**Fig 6.** Precalculation Time

In the above depicted figure 6 as the number of levels increases there is decrease in Precalculation time. So in this figure it is observed that there is optimization in Precalculation time. So in this figure there is inversely proportional relation between levels and Precalculation time

The equation of detection rate is as follows:

$$\frac{Number\ of\ correctly\ detected\ images}{Total\ number\ of\ images} * 100$$

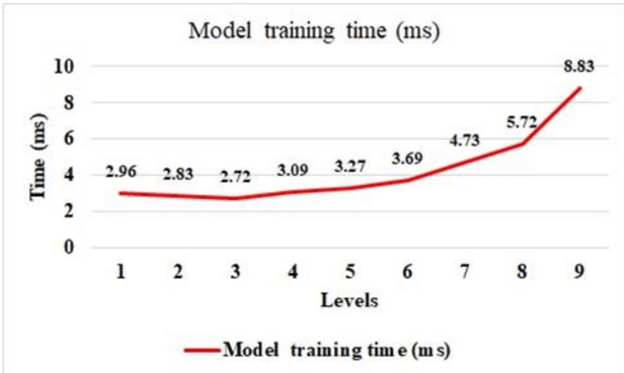


**Fig 7.** Model Training Time

In the above given figure 7 as the number of levels increases the time required for the training of the model is also increased.


**Fig 8.** Successful working of the system

## 4. Conclusion

The proposed system reduces the drawbacks of the traditional system and demonstrates the advantages of using image processing techniques in various areas such as jewelry stores, banks, hotels, airports, restricted areas, places of worship, security, healthcare, criminal identification, fake identity detection, for tagging, auto-focusing, real time surveillance. Finally we conclude that Since no single algorithm is ideal in every situation, it is not advised to use them. Knowing the problem to be solved and the algorithm that is most suited to solve it is the best way to select any algorithm. The proposed methods in this research article have done remarkable optimization in Precalculation time.

## 6. Future Scope

We have designed and implemented our application and experimented with users. The scope of the proposed system can be used anywhere for security reasons, such as jewelry stores, banks, hotels, airports, restricted areas, places of worship, security, healthcare, criminal identification, fake identity detection, for tagging, auto-focusing, surveillance and well-known locations with large crowds. The primary obstacles encountered by all algorithms include occlusion, intricate backdrops, illumination, and these issues are effectively handled by the lately popular algorithms like CNN and Federated Learning and Explainable Artificial Intelligence. For non-colocated datasets, an intelligent method based on Federated Learning (FL) will soon be required.

## References


[1] J. Fagertun, 2005. Face Recognition. Master Thesis, Technical University of Denmark (DTU).

[2] Navghare, Nilesh, et al. "Python and OpenCV in automation of live Surveillance." Machine Learning and Information Processing: Proceedings of ICMLIP 2019. Springer Singapore, 2020.

[3] Alniemi, O., Mahmood, H.F. (2023). Class attendance system based on face recognition. Revue d'Intelligence Artificielle, Vol. 37, No. 5, pp.1245-1253. https://doi.org/10.18280/ria.370517

[4] [Sevinç, E. (2022). An empowered AdaBoost algorithm implementation: A COVID-19 dataset study. Computers & Industrial Engineering, 165: 107912. https://doi.org/10.1016/j.cie.2021.107912

[5] Namah, A.A., Mirza, N.M., Al-Zuky, A.A. (2022).Target detection in video images using HOG-based cascade classifier. Revue d'Intelligence Artificielle, 36 (5): 709-715. https://doi.org/10.18280/ria.360507

[6] Xiang, W. (2022). The research and analysis of different face recognition algorithms. Journal of Physics: Conference Series, 2386(1): 012036. https://doi.org/10.1088/1742-6596/2386/1/01203

[7] Le, Dac-Nhuong, et al. "MMAS algorithm for features selection using 1D-DWT for video-based face recognition in the online video contextual advertisement user-oriented system." Journal of Global Information Management (JGIM) 25.4 (2017): 103-124.

[8] J. Mahreen, “Working with images and videos using opencv,” Analytics Vidhya, Aug 2022.

A. A. Al-blushi, “Face recognition based on artificial neural network: A review,” Artificial Intelligence Robotics Development Journal, vol. 1, no. 2, pp. 116–131, 2021.

[9] Hasan, Md Khaled, et al. "Human face detection techniques: A comprehensive review and future research directions." Electronics 10.19 (2021): 2354.

[10] Thampan, Navya, and Senthil Arumugam Muthukumaraswamy. "On the Studies and Analyzes of Facial Detection and Recognition Using Machine Learning Algorithms." Intelligent System Design: Proceedings of INDIA 2022. Singapore: Springer Nature Singapore, 2022. 15-27.

[11] N. Sharma, R. Sharma, N. Jindal, Machine learning and deep learning applications-a vision, Global Trans. Proc. 2 (1) (2021) 24–28, https://doi.org/10.1016/j.gltp.2021.01.004.

[12] Rahmad, C., Asmara, R.A., Putra, D.R.H., Dharma, I., Darmono, H., Muhiqqin, I. (2020). Comparison of ViolaJones Haar Cascade Classifier and Histogram of Oriented Gradients (HOG) for face detection. IOP Conference Series:Materials Science and Engineering,732(1): 012038. https://doi.org/10.1088/1757899X/732/1/012038

[13] F. Liu, Q. Zhao, X. Liu and D. Zeng, "Joint Face Alignment and 3D Face Reconstruction with Application to Face Recognition," in IEEE Transactions on Pattern Analysis and Machine Intelligence, , 1 March 2020, vol. 42, no. 3, pp. 664-678.

[14] Elias, S.J., Hatim, S.M., Hassan, N.A., Abd Latif, L.M., Ahmad, R.B., Darus, M.Y., Shahuddin, A.Z. (2019).Face recognition attendance system using Local Binary Pattern (LBP). Bulletin of Electrical Engineering and Informatics, 8(1): 239-245. https://doi.org/10.11591/eei.v8i1.1439

[15] Sunaryono, D., Siswantoro, J., Anggoro, R. (2021). An android based course attendance system using face recognition. Journal of King Saud University – Computer and Information Sciences, 33(3): 304-312. https://doi.org/10.1016/j.jksuci.2019.01.006

[16] M. Lal, K. Kumar, R. Hussain, A. Maitlo, S. Ali, and H.Shaikh, “Study of face recognition techniques: A survey,”International Journal of Advanced Computer Science and Applications, vol. 9, no. 6, 2018.

[17] Rahman, M.A.; Zayed, T. Viola-Jones Algorithm for Automatic Detection of Hyperbolic Regions in GPR Profiles of Bridge Decks.In Proceedings of the 2018 IEEE Southwest Symposium on Image Analysis and Interpretation (SSIAI), Las Vegas, NV, USA, 8–10 April 2018; pp. 1–4

[18] Jayant, Nazare Kanchan, and Surekha Borra. "Attendance management system using hybrid face recognition techniques." 2016 Conference on advances in signal processing (CASP). IEEE, 2016.

[19] Chen, M. Y., & Gladence, M. (2023). Guest Editorial - Deep Learning In Biomedical And Healthcare: Emerging Trends, Applications And Research Challenges. Journal of Mechanics in Medicine and Biology, 23(4), Article 2302002. https://doi.org/10.1142/S0219519423020025

[20] Srivastava, A.; Mane, S.; Shah, A.; Shrivastava, N.; Thakare, B. A survey of face detection algorithms. In Proceedings of the 2017 International Conference on Inventive Systems and Control (ICISC), JCT College of Engineering and Technology, Coimbatore, India, 19–20 January 2017; pp. 1–4.

[21] Marˇceti´c, D.; Ribari´c, S. Deformable part-based robust face detection under occlusion by using face decomposition into face components. In Proceedings of the 2016 39th International Convention on Information and Communication Technology,Electronics and Microelectronics (MIPRO), Opatija, Croatia, 30 May–3 June 2016; pp. 1365–1370

[22] Rao, K. Venkateswara, and L. Mary Gladence. "Support vector machine based disease classification model employing hasten eagle Cuculidae search optimization." Concurrency and Computation: Practice and Experience (2022): e7259

[23] Schroff, F., Kalenichenko, D., Philbin, J. (2015). FaceNet: A unified embedding for face recognition and clustering. In 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Boston, MA, USA, pp. 815-823. https://doi.org/10.1109/CVPR.2015.7298682

[24] R. S. Jamalullah, L.Mary Gladence, "Leveraging Brain MRI for Biomedical Alzheimer’s Disease Diagnosis Using Enhanced Manta Ray Foraging Optimization Based Deep Learning," in IEEE Access, vol. 11, pp. 81921-81929, 2023, doi:10.1109/ACCESS.2023.3294711.

[25] Kukla E, Nowak P (2015) Facial emotion recognition based on cascade of neural networks. Adv Intell Syst Comput 314:67–78. https://doi.org/10.1007/978-3-319-10383-9_7

[26] Al-Allaf, O.N. Review of face detection systems based artificial neural networks algorithms. arXiv 2014, arXiv:1404.1292.

[27] Kahate, Sandip A., and Atul D. Raut. "An Enhanced Data Confidentiality in Online Social Networks Using Quantum Key Management with a Blockchain Approach." 2023 14th International Conference on Computing Communication and Networking Technologies (ICCCNT). IEEE, 2023.

[28] D. N. Parmar and B. B. Mehta, “Face recognition methods applications,” Int. J. Computer Technology Applications, pp.84–86, 2013.

[29] Rezaei, Mahdi. (2013) "Creating a cascade of haar-like classifiers: Step by step." Aplikasi Pendeteksian Ras kucing dengan mendeteksi wajah kucing dengan metode viola jones.

[30] Viola, Paul, and Michael Jones 1 (2001) "Rapid object detection using a boosted cascade of simple features" CVPR (1) 511-518.

[31] [32] Amit, Yali, Donald German, and Kenneth Wilder (1997) “Joint induction of shape features and tree classifiers” *IEEE Transactions on Pattern Analysis & Machine Intelligence* 11: 1300-1305.

[32] Sung, Kah K., and Tomaso Poggio (1994) “*Example Based Learning for View-Based Human Face Detection*” Massachusetts Inst of tech Cambridge artificial intelligence lab, no. ai-m-1521.

[33] elsaid, w. k. "A System for Managing Attendance of Academic Staff Members in University Development Programs using Face Recognition."

[34] Schneiderman, Henry, and Takeo Kanade (2000) “A statistical approach to 3D object detection applied to faces and cars” Carnegie Mellon University, the Robotics Institute. Creating a Cascade of Haar-Like Classifiers: Step by Step

[35] Greenspan, Hayit, et al. (1994) "Overcomplete steerable pyramid filters and rotation invariance" 222-228.

[36] Itti, Laurent, Christof Koch, and Ernst Niebur. (1998) "A model of saliency-based visual attention for rapid scene analysis" IEEE Transactions on Pattern Analysis & Machine Intelligence 11: 1254-1259.

[37] Osuna, Edgar, Robert Freund, and Federico Girosi. (1997) "Training support vector machines: an application to face detection." *cvpr*. Vol. 97. No. 130-136.

[38] Fleuret, Francois, and Donald Geman. (2001) "Coarse-to-fine face detection” *International Journal of computer vision* 41.1-2: 85-107.

[39] Schapire, Robert E., et al. (1998) "Boosting the margin: A new explanation for the effectiveness of voting methods" *The annals of statistics* 26.5: 1651-1686.

[40] Tsotsos, John K., et al. (1995) "Modeling visual attention via selective tuning." *Artificial intelligence* 78.1-2: 507-545.

[41] Mahdi Rezaei “Creating a cascade of Harr like classifiers “Department of computer science, Auckland.