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Article *in* International Journal of Intelligent Systems and Applications · September 2013

DOI: 10.5815/ijisa.2013.10.11

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I.J. Intelligent Systems and Applications, **2013, 10, 86-92**
Published Online September 2013 in MECS (http://www.mecs-press.org/)
DOI: 10.5815/ijisa.2013.10.11

An Intelligent Alarm Based Visual Eye Tracking Algorithm for Cheating Free Examination System

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Abstract— A modern and well established education system is a backbone of any nation's success. High reputation in international platform can only be achieved when best and deserving students represent your country and earn reputation on their ability and dedication. For this purpose an education system must be a cheating free system so that non-deserving students should not get the positions which they don't deserve. This research aims to develop such a system which can be used in exam halls to avoid the cheating based on student's eye movement. The algorithm detects the human from the scene followed by the face detection and recognition. The next phase involves eye detection followed by eye's movement tracking to analyze and decide about whether the student is involved in cheating or not. The system can be used on a large scale in educational institutions as well as in corporate sector wherever exams have been conducted.

Index Terms— Eye's Detection, Eye Movement Tracking Face Detection, Face Recognition, Segmentation

I. Introduction

Face alignment is an important issue and factor in face recognizing systems. Scaling and rotation of the facial images is performed in order to match with the trained images of databases. It is already shown that the face alignment has a large impact on recognition accuracy [1, 2]. Using eyes positions, face alignment is detected and performed. In the automated face and eye detection systems, eye positions are given but it is not appropriate solution and realistic for real world systems. For resolving such issues there is a need of automatic eye detection system which can be used for recognizing faces automatically.

Face and eye reading research presented the statistics and information which is of key importance to law enforcement institutions. By reading face and eyes, experts usually extracts quite useful information while interrogation of suspected peoples and criminals. This makes Eye Tracking and Tracing an important and hot topic in new modern research. Due to security issues and other different problems these applications and system can help biometric algorithms and applications, security software and systems as well as in interfaces for intelligent human interaction with computer [3].

The problems faced during processing can be addressed by localizing and extracting eyes. It has been observed that eyes localization can be solved using different technologies. A sample of eye template is obtained which is compared with the images of faces for detection. Characteristic detection algorithm processes the corners and edges obtained from the facial images for detection of eyes. Machine learning systems uses eyes regions and non-eye templates for eye recognition. Skin toning, image contrast technology is used for the face extraction and detection [4, 5].

GCP algorithm has been used for obtaining eye position and location [6]. Eye has been detected using Haar algorithm with high efficiency [7]. High efficiency obtained by training sample images for object detection and eye detection rapidly.

This paper has presented an efficient and effective algorithm for face and eye detection. Eye Detection has been achieved by using pixel intensity and edges information while processing low resolution images. Eye movement has been analyzed for highlighting the main problem area of detecting the students involved in cheating during the examination.

The organization of the paper is as follows. Section II presents the literature section. Development methodology has been discussed in Section III. Section IV and V presents the Conclusion and Future Work respectively.

II. Literature Review

Hori, Sakano, Saitoh [8] proposed a system for disabled persons who cannot speak. They developed system to use eye blinks for the communication purpose. Horizontal and vertical oculograms are measured using different electrodes. Virtual screen boards used this system and this system is improved by the proposed system.

Kin and Robert [9] proposed a face detection system on the basis of feature extraction. They used many probabilistic models to extract the features of face. This

system uses many spatial filters to find the feature points from the face and group them into different groups and then classify those features based on many probabilistic models. This system gives very satisfying results based on probabilistic models.

Pawan, Benjamin, Yuri, and Richard [10] proposed a system for face recognition and get very satisfying results. They have tried to match the performance of the system to match with the human perception rate. All those points are considered and a model is formed which can easily recognize faces. They study all the basic building blocks of human visual system which gives them the basic points which uses to recognize the human faces. In this paper they show 19 different results which give the results and implications involved in this research.

Michael and Margrit [11] proposed a system for paralyzed people who can't control their bodies or any other part except their eyes. So eye motion and blink tracking is most important thing to handle this research. They used online templates to check the blinks of the eyes and these blinks are taken as mouse clicks.

There is no need for the offline templates and by the rapid movement of the head, this system can be reinitialized. Which is a very good step for this type of research and it only requires a USB camera which works on 30 frames per second. They have tested this system on very large scale and it gives very satisfactory results.

Wolf, Felix, Scholkopf, and Franz [12] proposed a system for eye movement system which uses interest operators and those operators can be used by machine learning processes in contrast to the existing system which are based on handmade templates. They have worked on a whole process of data collection, training and testing and showed very satisfactory results.

Kah-Kay and Tomaso [13] has worked on the human face recognition in complex scenes. The technique used by them basically classifies scenes as face portion and non-face portion. They have trained a classifier for the detection and recognition of human faces. That classifier draws a feature vector and then decides whether that portion is face or not. They have showed that both face clusters and non-face clusters are equally important in this research.

Andras, Adam, Barna, Peter Baranyi [14] has worked on retinal movement and the scene judgment through retinal movement. They have explained how different edge detection techniques and algorithm works using biological inspired basis.

So by the modern research in cognitive retina these techniques are disapproved. This paper works on a hypothesis that involuntary eye movement may be responsible for the compensation in loss of information which is caused by different issues. This paper shows different models and simulations which proves this hypothesis.

Selker, Lockerd and Martinez [15] proposed a system which can be used to store information from human eye and can transfer some-where with the help of IR. This system track eye movements and then collects information. Basically this system recognize gaze of human eye and once eye is fix at any point then it collect the information in any direction. This system is based on glasses and eye-movement.

III. Development Methodology

The proposed research work is our contribution to knowledge in which an effort has been made to present an intelligent visual eye tracking algorithm for free and fair examination system. Fig. 1 shows the architecture of the proposed algorithm.

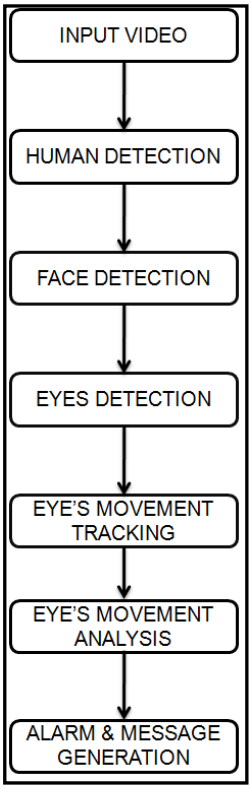

Fig. 1: System Architecture

The initial step of the proposed algorithm is input video acquisition. The input video acquisition modes differ for different conditions. The proposed system uses the videos obtained from the examination hall of the Master Degree Program students during their semester exam. The captured video has been processed for enhancement purposes in the preprocessing stage just before the actual processing.

The first main phase of the proposed algorithm involves human detection from the captured scene.

Successful human detection has been processed further for eye's detection.Eyes detection leads to eye movement detection. Eyes detection has been

performed by using canny edge detection. The boundaries / edges achieved have been analyzed by template matching [16].

In order to avoid the lost information during the edges detection, geometric information analysis has been performed. Detected eyes has been processed furthers for analysis of eye movement detection. For eye's movement detection pupil detection has been performed. Pupil of the eye has been detected using Kalman filtration algorithm [16].

Fig. 2 explains the algorithm for cheating detection in detail. Input video captured from the economical camera has been processed for frames detection. Each frame detected worked and processed as image. Input frame processed for the proposed cheating detection algorithm has been shown in Figure 3.

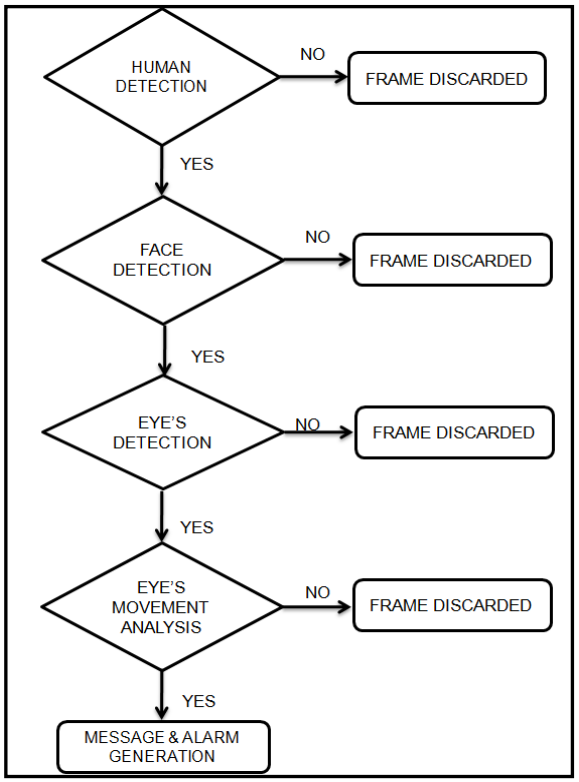

Fig. 2: Cheating Detection Algorithm

Fig. 3: Input Video Frame

Input video has been used from different sources. Camera used could be at different angle view. Proposed algorithm has only addressed the videos and images obtained from the frontal view. Frontal camera view helped in easy human facedetection. Human face detection and eyes detection could be done from the side view also but pupil and eyes movement cannot be analyzed and no decision could be taken for either cheating underway or calm situation.

Fig. 3 depicts one of the student appeared in the MS Final Semester Examination. Fig. 3 shows only one student. Proposed algorithm has been trained and tested for different condition of videos and images processing.

The frames of input video have been processed for human face detection. Many algorithms have been developed for the human face detection. The proposed algorithm has used Viola Jones face detection algorithm [17]. The reason behind the usage was that, it produced extremely excellent results in low resolution and with usage of economical cameras. Fig. 4 shows the result of successful human detection.

Fig. 4: Human Successful Detection

If the human face not detected than frame would be discarded and next frame would be processed. After human face detection, next step followed by the proposed algorithm has been of eye detection. It has been extension of Viola Jones [17] for eye detection. Fig. 5 shows the resultant of eye detection marking the face with eyes with red box showing successful eyes detection.

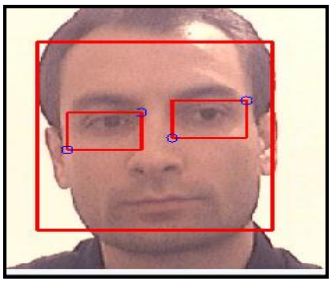

Fig. 5: Eye's Detection

If the input processing frame result produced lead to no eye detection, frame would be discarded as described in the Fig. 2. Resultant images of successful eyes detection has been processed for eyes movement tracking and analysis. For eye movement, first of all eye portion separated by image segmentation [18]. The eye portion segmented for further processing has been shown in fig. 6.

Fig. 6: Eye Segmentation

Eye portion for both left and right eye separated and labeled for further processing. Segmentation has been performed to get and work on only eye portion to achieve the objectives of proposed algorithm.

The pupil is detected by applying differentiation of gray levels by means of white portion and black portion after eye segmentation. Pupil detection has been achieved by template matching followed by the detection of pupil axis. The process has been applied to both right and left eyes. Eyes detection has been shown in Fig. 7 by the small bounding boxes of red color and pupils have been marked by blue color edges.

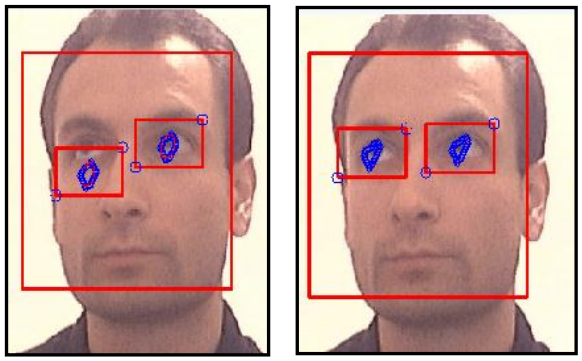

Fig.7: Pupil Detection

The pupil axis has been obtained after pupil detection. Initially value of pupil would be zero. The analysis for pupil position and direction has been shown in Figure 8.

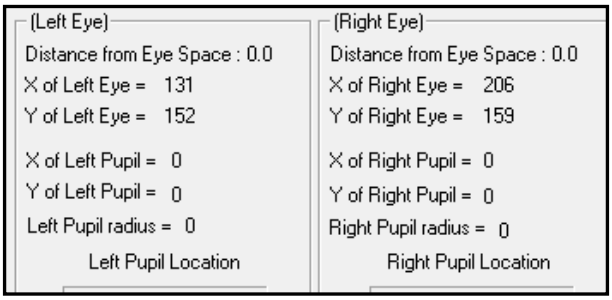

Fig. 8: Pupil Axis Directions and Position Analysis

Fig. 8 shows the value at start. It shows the eye distance from nose as well as the pupil axis calculated. Movement of pupil changes the axis direction as well as position and distance from region. When pupil moved the values changed for both right eye as well as left eye. When the person moved eyes to right i-e moved pupil to right side pupil axis detected has been shown in the Fig. 9.

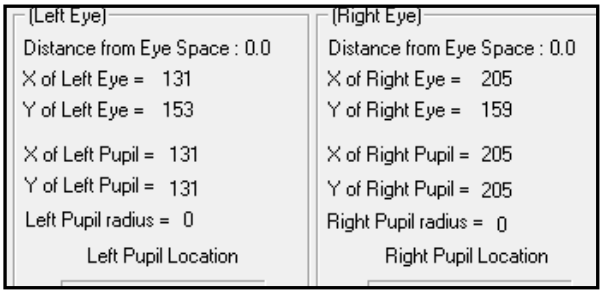

Fig. 9: Pupil Axis Direction and Position Analysis with view on left side

The movement of pupil has been detected and their analysis has been shown in Fig. 10.Movement of pupil on the either left or right side would change both side axis values.

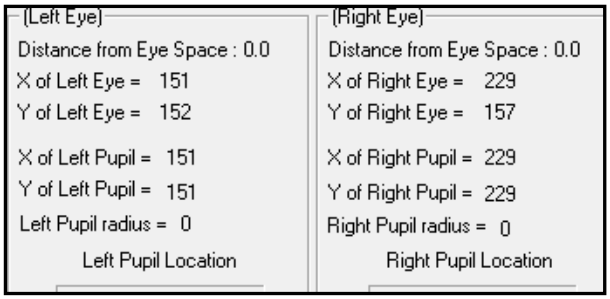

Fig. 10: Pupil Axis Direction and Position Analysis with view on right side

Analysis of each input processed frame has been performed and comparison has been performed with the previous frame. The comparison analysis declares the movement of student's eye in case of any cheating activity in which student involved.

Remarkable difference that satisfies the threshold value between both the previous and current axis values results in the declaration of cheating case capturing and alarm generated. Figure 11 shows the view of both when eye moved to left side as well as to the right side.

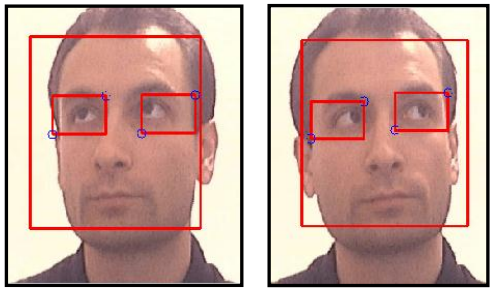

Fig. 11: People view on both left side as well as on right side

The proposed algorithm has been trained over the dataset of 10 videos. Designed algorithm has been successfully tested for the detection of cheating students during the examination.The proposed algorithm is efficient and versatile. It has been efficient

in terms of processing time. Proposed algorithm generated message of detecting cheating successfully as shown below in fig. 12.

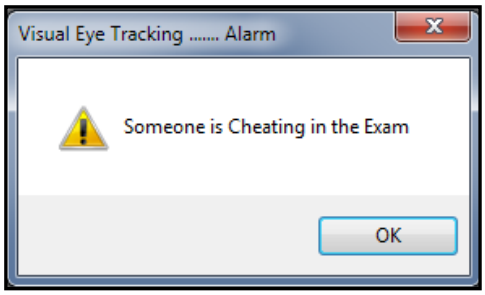

Fig. 12: Messages for Cheating Detection Successfully

The proposed system has been tested and compared with different algorithms. Testing has been performed under different conditions and circumstances.

Table 1: Comparison of Time Processing with Windows XP as OS

Ser	Algorithm	Processing Time	OS
1	Viola Jones	5 Sec	Windows XP
2	SVM	4 Sec	Windows XP
3	Tree Classifier	3.8 Sec	Windows XP
4	EOG	3.3 Sec	Windows XP
5	DWT-BD	1.7 Sec	Windows XP
6	Proposed Algorithm	0.9 Sec	Windows XP

Table 1 explains the comparison of proposed algorithm with already developed algorithm in respect of time processing for fixed Operating System.

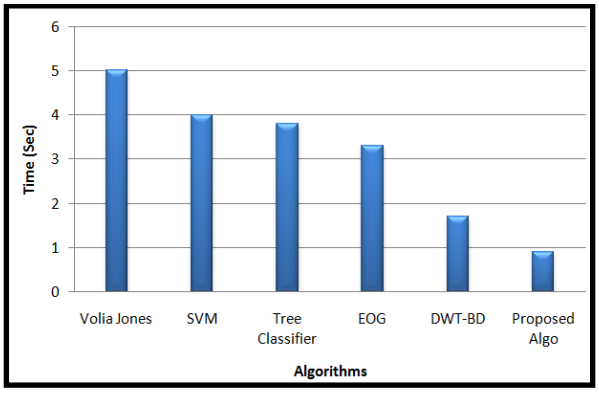

Fig. 13: Time Processing Graph

Fig. 13 shows the graphical representation of time processing elapsed for the different algorithms. Graph shows the line coming downwards as we move from right to left means proposed algorithm consumed minimum time for the processing. Proposed algorithm consumed 0.9 Sec for processing whereas Viola System consumed 5 Sec and DWT-BD consumed 1.8 Sec.

When the proposed algorithm has been compared for the success ratio, proposed algorithm has highest success rate. A dataset of 20 videos has been tested over the proposed algorithm and other developed algorithm. Each video has been tested for all above discussed algorithms. ViolaJones human detection algorithm detected eye movement up to 78% successfully.

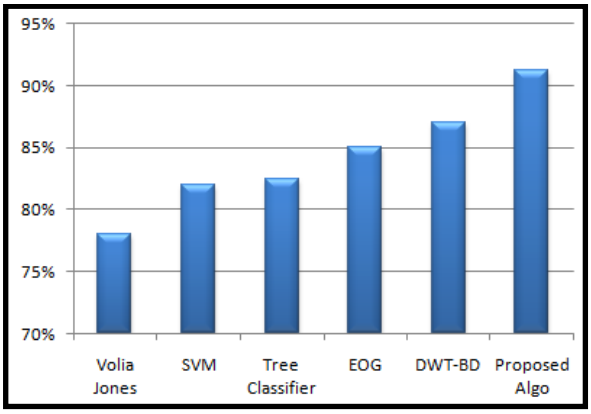

Fig. 14: Success Ratio

Fig. 14 shows the success ratio graph of proposed algorithm and already developed algorithms. Proposed system detected the eyes movement successfully up to 93%. That was highest successful rate achieved yet in the developed algorithms.

Proposed algorithm has been tested using dataset of images with different resolution camera as well as under different light conditions. Proposed algorithm produced best results under all conditions and circumstances.

IV. Conclusion

For deployment of transparent and fair examination system, algorithm has been designed. The algorithm has been proposed for human face detection from the low resolution images. Pupil movement has been observed by the proposed algorithm continually for eyes movement detection. Eyes movement detection is monitored for observing the students involved in the cheating during examination.

It provided efficient solution for monitoring entry test examinations students and implementing the fair examination system. It can also be used for academic and scientific research.

V. Future Work

The proposed algorithm has covered the detection of cheating students of maximum 3 in the groups. The system can be extended for detecting the more than 5 students from one frame.

The proposed system can be extended to discover the students involved in cheating from the side view capture as the proposed algorithm has not addressed the problem from the side view. In the proposed algorithm, input video processed has been captured from the front view.

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