International Journal of Pure and Applied Mathematics
Volume 117 No. 22 2017, 71-75
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue

ijpam.eu

COMPARATIVE ANALYSIS OF EYE DETECTION AND TRACKING ALGORITHMS FOR SURVEILLANCE

G. Vishnuvardhan Rao[1], Madhusudhana Reddy Barusu[2],Praveen Kumar.E[3], Sakana.G[4]
[1] Electronics and Communication Engineering
[1] Veltech Multitech Dr.Rangarajan Dr.Sakunthala Engg College
Avadi, Chennai-600062, India
[1] gadipudir@gmail.com
[2,3,4] Electronics and Communication Engineering
[2,3,4] Veltech Hightech Dr.Rangarajan Dr.Sakunthala Engg College,
[2,3,4] Avadi, Chennai-600062, India
[2] madhu.barusu@gmail.com , [3]epraveenkumar10@gmail.com,[4]saha250891@gmail.com

ABSTRACT

Surveillance is performed with various techniques like face detection, thermal imaging techniques and etc. Thermal imaging technique identifies body temperature and indicates the presence of a living object, whereas it cannot differentiate animal or human being. The face detection is another method for surveillance. This method differentiates animal and the human being with the face but suffers from low accuracy. So, in this paper, various algorithms like support vector machines algorithm, naïve Bayes algorithm and AdaBoost algorithm to detect and track the eye for surveillance are analyzed and compared. These algorithms identify human beings with better accuracy.

Key Words: Support vector machines algorithm, naive Bayes algorithm, AdaBoost algorithm, Surveillance.

1.Introduction

Surveillance is performed by various techniques like face recognition, thermal imaging and etc. These methods suffer from various short comings like low visual power to compute, development of efficient visual feature extracting algorithms, high processing power for retrieval from a huge image database and processing perfect matrix operation. Hence, this directs to handle with a huge frame and focus on the new algorithms which are more real-time and more efficient with maximum accuracy i.e. eye detection for surveillance. Applications of eye detection are widely spreading in the area such as security system, image and film processing. From the sequence of the frame captured by the capturing device, the eye is required to identify. Then processing the captured frame is divided into real time eye detection and eye tracking. There are two ways of detection and tracking of eyes. The first method is using eye detection algorithms, which can get timely frames containing the eyes information and directly get eye tracking. The second method is detecting eye in the starting frame and then implement the eye tracking algorithm for following the eye in the other frame[1].

The rest of the paper is organized as section II is literature survey and section III gives details of existing algorithms. Section IV gives block diagram of the system used and section V gives comparative results of various algorithms. Section VI concludes the paper.

2.Literature survey

The new applications of video processing like biometric face detection and recognition, eye detection are emerged with the advancement of computer technology in modern days [2]. The IR LEDs and CCD camera can be used to detect the eye gazing by mapping of carnel reflections. The method has advantages like the direction of the user's eye gaze can be computed without computing the geometrical relation between the eye, the camera and the monitor in 3D space and simple[3], but the method is useful only if user gazes at the computer. The eye gaze trackers have two main challenges during human computer interactions i.e. need to calibrate individually for each user and low tolerance for head movement [4]. The eye anatomy analysis allows natural head movement and minimizes the calibration procedure to only one time for a new individual. The method is more complex as it requires analyzing the anatomy of the eye. The method for

surveillance is face detection. The face is tracked and detected with the single surveillance camera. The histogram of gradient technique is used for analyzing the detected results. The motion and appearance likelihood helps to filter out false positives. Then all the true positives are tracked by a tracking algorithm based on earth mover's distance (EMD) and SURF points[5]. The Haar features for detecting and recognition of face improves the time of processing, with the system segregation of into simple steps like motion detection, face detection and recognition, human intervention is reduced and system efficiency is increased. Motion detection reduces the search area and processing complexity of systems[6]. The different methods used for eye and face detection have short comings. To compare the performance of eye tracking algorithms, in this paper, a set of algorithms analyzed.

3.Eye detection and tracking algorithms

Eye detection is a method of detecting all possible information about human eye like location and size in the captured frame, which is more complicated than identifying the number of eyes in the known frame. In many applications like biometrics recognition and multimedia applications, eye detection is the primary and first step for analysis. However, eye detection and tracking are not a directly done, as it has a lot of variations such as post variation (front, non-front), image orientation, illuminating condition and facial expression. Eye tracking is a process, which measures the location, orientation of eye, a point of gaze and the motion of an eye relative to the head. There are various algorithms for measuring eye tracking like Naive Bayes, Support Vector Machine (SVM) [7] and AdaBoost algorithms[8][9].

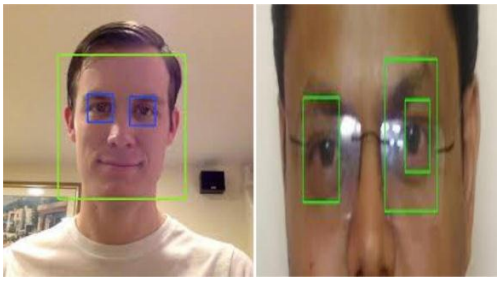


Fig 1 Eye Detection and Tracking

3.1. Naive bayes classifier

Bayesian classifiers are statistical classifiers. They can predict class membership probabilities. Naïve Bayes classifier works on the principle of the joint probabilities of the words and assumes that conditional probability of given word is independent of other words from the same category[10]. This principle and assumption make naïve Bayes more efficient than non-naïve Bayes approaches.

3.2. Support vector machine classifier (SVM)

SVM is a non-probabilistic binary linear algorithm; it assigns each new example to some category. The SVM algorithm separates categories by a clear gap with maximum wide, represents and maps the examples as points in space. The new examples are then mapped and predicted to which category it falls. The mappings used in SVM are designed such that it reduces the computational load and makes dot product simple.

3.3. Adaboost classifier

The AdaBoost algorithm is an adaptive system, where the final output of all the weak algorithms are combined and analyzed as the weighted sum. This is more sensitive to noisy data but at certain over fitting problems, it is less susceptible than other algorithms. The individual algorithms may not converge to a stronger, but as long as the error is smaller, the final model .i.e. combination of all may converge to stronger. The algorithm is perfect and more accuracy, less time consumption. Fig.2 shows the comparison of various algorithms regarding nature of decision boundaries. In high dimensional data can be organized better by naïve Bayes, SVM and AdaBoost algorithms. The solid colors are training points and semi-transparent points are testing points. The accuracy is specified lower right.

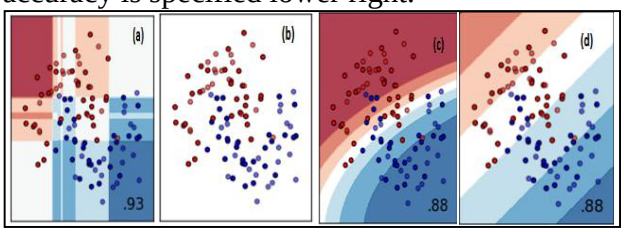


Fig.2. Nature of decision boundaries for various algorithms.

4.Hardware implementation

The goal of the paper is to compare the performance of the various eye detection and tracking algorithms. The various classifiers used for comparison are Naive Bayes, Support Vector Machine (SVM) [7] and AdaBoost algorithms[8][9]. Fig.3. shows an overall block diagram of experimental setup for capturing and analyzing the image. It contains a camera to capture eye movement. The captured image is fed to the laptop, which contains MATLAB software, to analyze the input image. The output from MATLAB is fed to the microcontroller for further action.

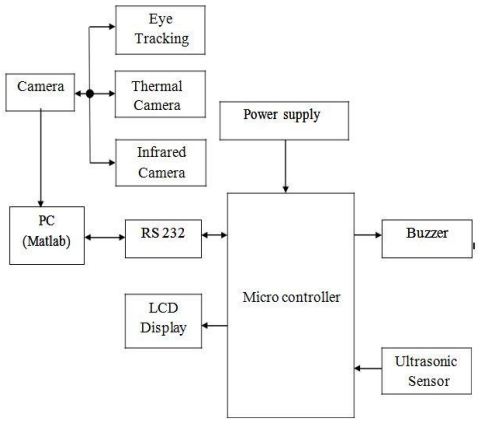


Fig.3. Overall Block Diagram

5. Result analysis

Fig.4. shows a frame of the captured video in MATLAB window, it contains many eyes instead of getting a single pair of eyes. The distance of center points of these rectangles has been calculated. If this distance is smaller than a pre-set threshold, the average of these rectangles will be computed and set as the final position of the detected eye. When an eye is been detected through the port interface MATLAB initiates the ultrasonic to calculate the distance of the person. Distance is been calculated and a buzzer alert is been given. Table.1. gives the comparison of the various algorithms for eye detection and tracking. The AdaBoost algorithm takes more time and leaf spot compared to other, but the AdaBoost is the more accurate method with approximately 92%. This method is simpler in implementation compared to others.

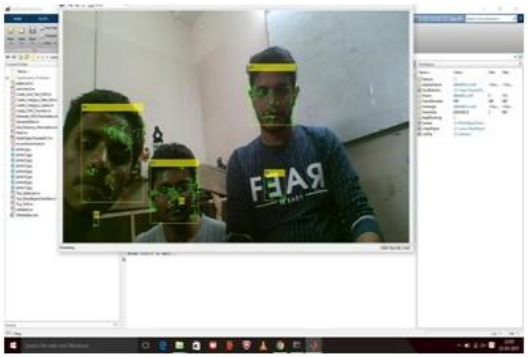
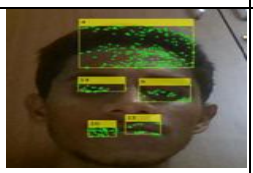


Fig.4. Output in MATLAB

6. Conclusion

In this paper, the various algorithms for eye tracking and detection for surveillance are presented. In these algorithms, AdaBoost is more accurate than other algorithms. The other algorithms suffer from low accuracy, difficulty in recognizing and differentiating the eye of the human and animal. The AdaBoost eye tracking algorithm over comes all the above drawbacks. This method has more accuracy and able to differentiate humans with other by using the available data base. The distance of the person from base point also identified accurately, so, necessary action can be taken for security purposes.

Table.1.Comparision of the various algorithms for eye detection and tracking

S.NO	ALGORITHM	IMAGE	ACCURACY	TIME	ALTERNARIA LEAF SPOT	REMARK
1	ADABOOST CLASSIFIER		92.00%	0.0203 s	0.122	Very simple to Implement, does feature selection resulting in relatively simple classifier.
2	NAÏVE BAYES		88.00%	0.0010 s	0.022	Requires a small amount of training data to estimate the parameters
3	SUPPORT VECTOR MACHINES		89.00%	0.0010 s	0.034	Less over fitting, robust to noise.

REFERENCES

[1] K. P. R and R. K. P, "Face Tracking and Robot Shoot," *Int. J. Appl. or Innov. Eng. Manag.*, vol. 2, no. 12, pp. 461–469, 2013.

[2] J. L. Xiao-ming Wang, Chang Huang, Guo-yu Ni, "Face Recognition Based on Face Gabor Image and SVM," in *2nd International Congress on Image and Signal Processing, 2009 (CISP '09), Tianjin, China.*, 2009.

[3] D. H. Yoo, J. H. Kim, B. R. Lee, and M. J. Chung, "Non-contact eye gaze tracking system by mapping of corneal reflections," *Proc. - 5th IEEE Int. Conf. Autom. Face Gesture Recognition, FGR 2002*, pp. 101–106, 2002.

[4] Z. Zhu and Q. Ji, "Novel eye gaze tracking techniques under natural head movement," *IEEE Trans. Biomed. Eng.*, vol. 54, no. 12, pp. 2246–2260, 2007.

[5] D. Xie, L. Dang, and R. Tong, "Video based head detection and tracking surveillance system," *Proc. - 2012 9th Int. Conf. Fuzzy Syst. Knowl. Discov. FSKD 2012*, no. Fskd, pp. 2832–2836, 2012.

[6] S. P. N. Tathe, S V, A. S. Narote, "Human Face Detection and Recognition in Videos," in *Intl. Conference on Advances in Computing, Communications and Informatics (ICACCI), Sept. 21-24, 2016*, 2016, pp. 2200–2205.

[7] S. D. Labhade, Jyoti Dnyaneshwar, L. K. Chouthmol, "Diabetic Retinopathy Detection Using Soft Computing Techniques," in *International Conference on Automatic Control and Dynamic Optimization Techniques (ICACDOT)*, 2016, pp. 175–178.

[8] X. C. Benke Xiang, "Eye Detection Based on Improved AD AdaBoost Algorithm," in *2nd International Conference on Signal Processing Systems (ICSPS)*, 2010, pp. 617–620.

[9] E. Applications, X. Li, Q. Wu, Y. Kou, L. Hou, and H. Xie, "Driver's Eye s State Detection Based on Adaboost Algorithm and Image Complexity," in *Sixth International Conference on Intelligent Systems Design and Engineering Applications Driver's*, 2015, pp. 349–352.

[10] P. Meesad, P. Boonrawd, and V. Nuipian, "A Chi-Square-Test for Word Importance Differentiation in Text Classification," in *International Conference on Information and Electronics Engineering*, 2011, vol. 6, pp. 110–114.