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Dataset for the evaluation of eye detectors for gaze estimation

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Outline

- Introduction
- Objective
- Gi4E
- Haar Classifiers
- Experiments
- Results
- Conclusions

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Introduction

- Goals for Eye Tracking Technology
  - Low cost eye tracking, i.e. web cam
  - More versatile and simple systems
    - Video games
    - Automotive industry
- Technical Challenges
  - New image processing techniques
  - New methods for gaze estimation

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Introduction

- Iris center detection is key for low cost eye tracking based on a web cam
- New datasets are required to evaluate low cost eye tracking methods
- These datasets should contain images acquired with low cost hardware and different gaze directions
- Most face databases contain subjects gazing at the front: YALE, BioID etc.

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Objective

- The objective of this work is to create a face database, based on a web cam, of users gazing at different points in the screen
- Images should be annotated by experts
- Public Haar classifiers are evaluated to test their ability to detect the eyes when they rotate

M. C. Santana, O. Deniz-Suaez, D. Hernandez-Sosa, and J. Lorenzo. A comparison of face and facial feature detectors based on the viola-jones general object detection framework. Mach. Vis. Appl., 22(3):481–494,2011.

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Gi4E

- Gaze Interaction For Everybody
- Gi4e is a public database of subjects sitting in front of the computer gazing at 12 different points in the screen
- The dataset consists of 1236 colour images from 103 different subjects aged from 18 to 83 years old, males and females
- For each user 12 images are recorded
- The set of images was acquired using a low cost web cam, with automatic lighting correction, and the image size is 800x600 pixels
- No other equipment or specific illumination such as infrared was used in image acquisition

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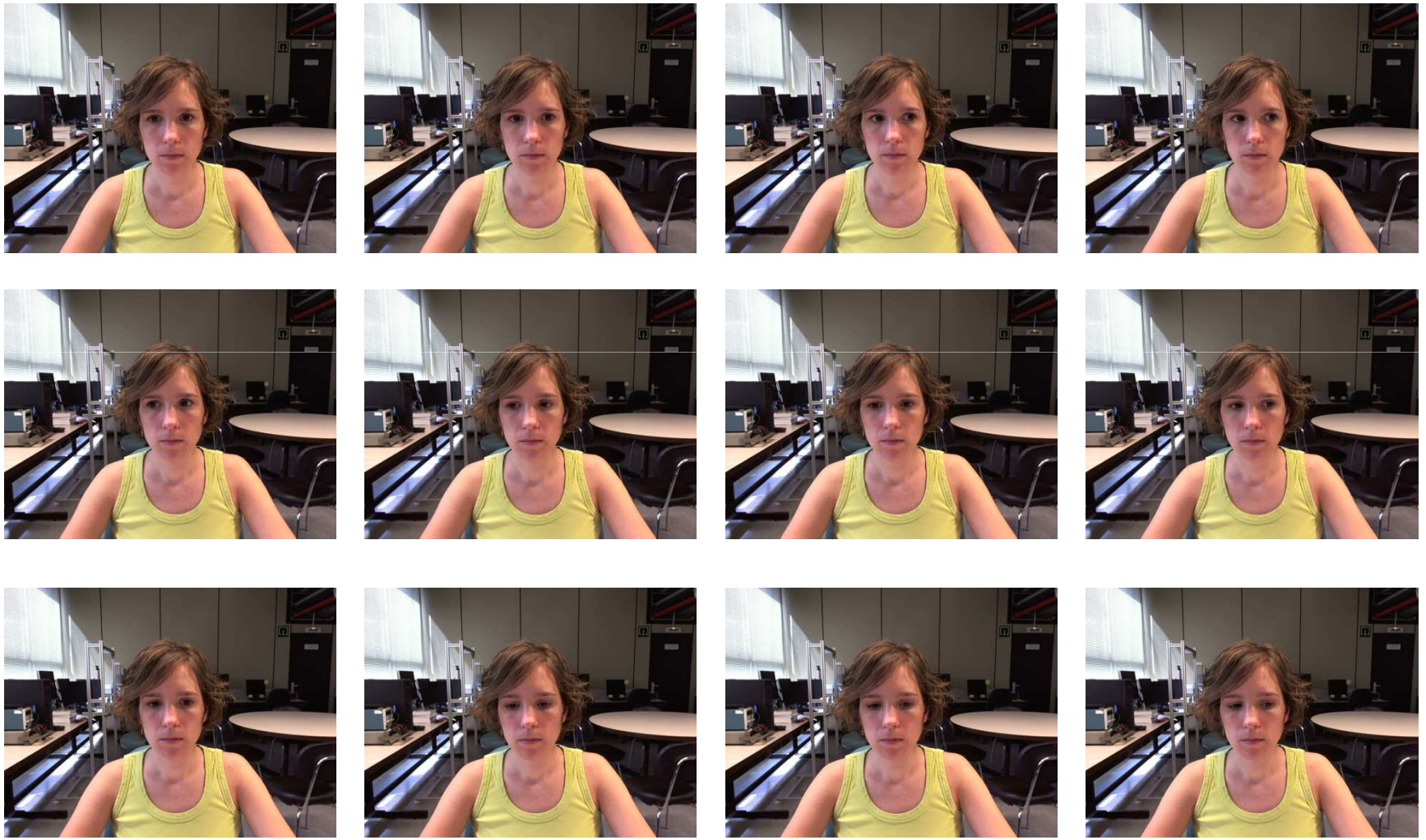
Gi4E



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Gi4E

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Gi4E

- The database is public and images have been annotated by three different experts, i.e. eye corners and iris centers

	Right eye			**Left eye**		
Image name	OC (x,y)	C (x,y)	IC (x,y)	IC (x,y)	C (x,y)	OC (x,y)

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Haar Classifiers

- Haar classifiers are based on the idea of a boosted cascade of weak classifiers
- Each stage classifier is selected considering a combination of features which are computed on the integral image
- Multi-stage object classifiers are widely used for object detection, i.e. facial features detection

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Haar Classifiers

- Our objective is to evaluate the performance of Haar classifiers in presence of eye rotation
- The public classifiers were already trained to detect eyes
- If different classifiers have been trained for right and left eye➔ *specific eye classifier*
- If a single classifier has been trained for both eyes➔ *non specific eye classifier*

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Haar Classifiers

Type	Reference	Availability	Size	Stages	Label
S	[14]	[3]	20x20	20	SY
S	[6]	[3]	18x12	20	C
NS	[13]	[13]	25x15	5	W
NS	[2]	[3]	20x20	24	S
NS	[8]	[3]	24x12	104	TS

2. S. Hameed. Eye cascade. http://umich.edu/ shameem, 2008.

3. Intel. Intel open source computer vision library. http://sourceforge.net/projects/opencvlibrary/, 2008.

6. M. C. Santana, O. Deniz-Suaez, D. Hernandez-Sosa, and J. Lorenzo. A comparison of face and facial feature detectors based on the viola-jones general object detection framework. Mach. Vis. Appl., 22(3):481–494,2011

8. T. Shan. Security and surveillance. http://www.itee.uq. edu.au/ sas/people.htm, 2008.

13. M. Wimmer. http://www9old.in.tum.de/people/ wimmerm/se/project.eyefinder/.

14. S. Yu. Tree-based 2020 eye detectors. http://yushiqi.cn/research/eyedetection, 2009

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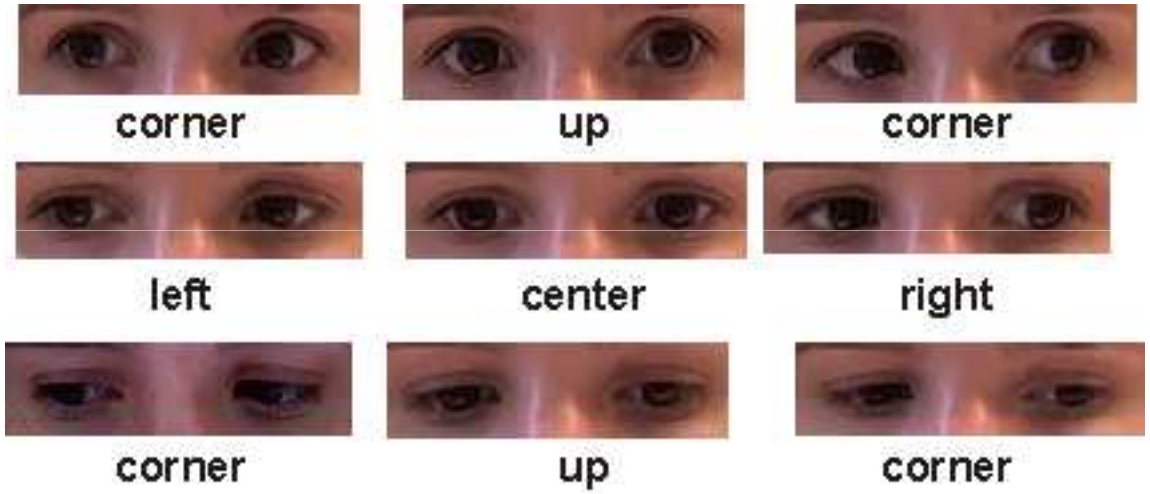
Experiments

- Images are classified in categories as follows



- The classifiers are evaluated in center and corner categories

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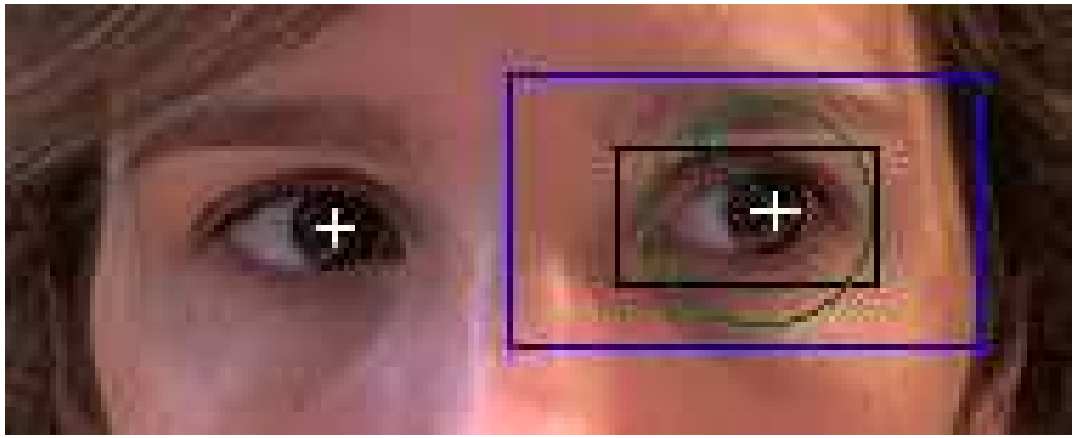
Experiments

- Distance between the centre of the detected eye, and the centre of the labelled eye must be smaller than one quarter of the distance between the annotated eyes
- The width of the detected rectangle must be smaller than two times the width of a reference rectangle that surrounds the region limited by the eye corners



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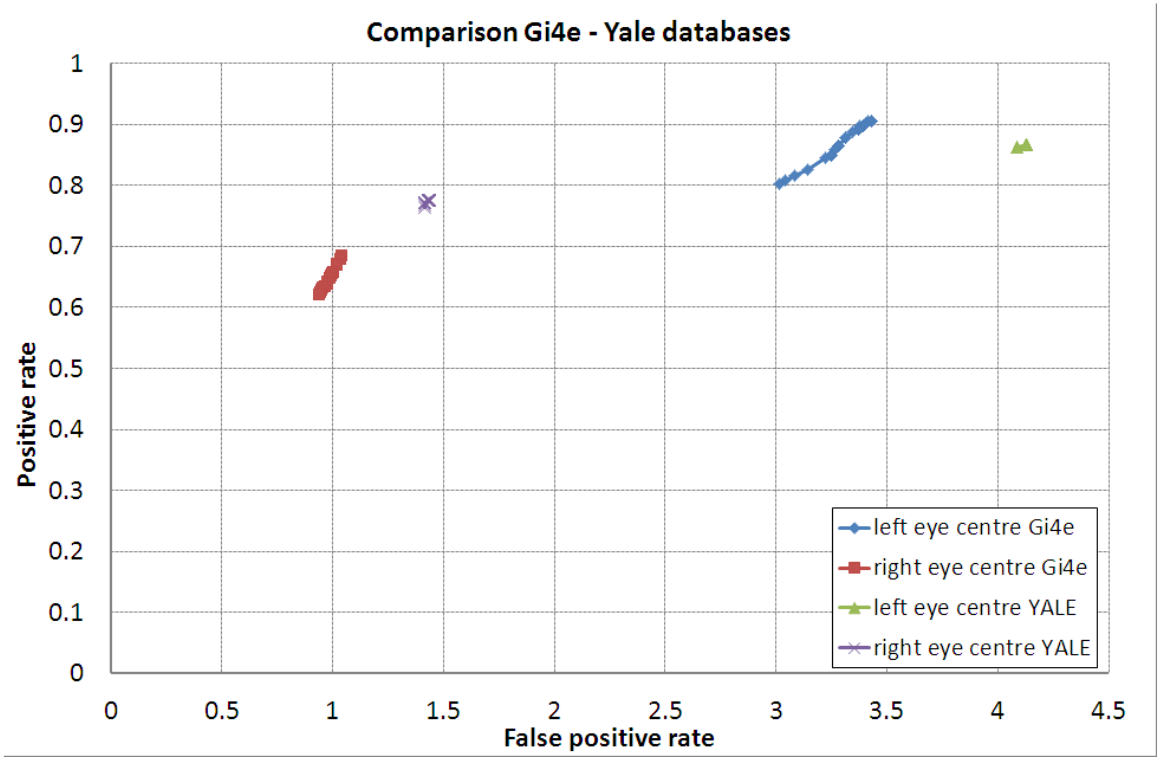
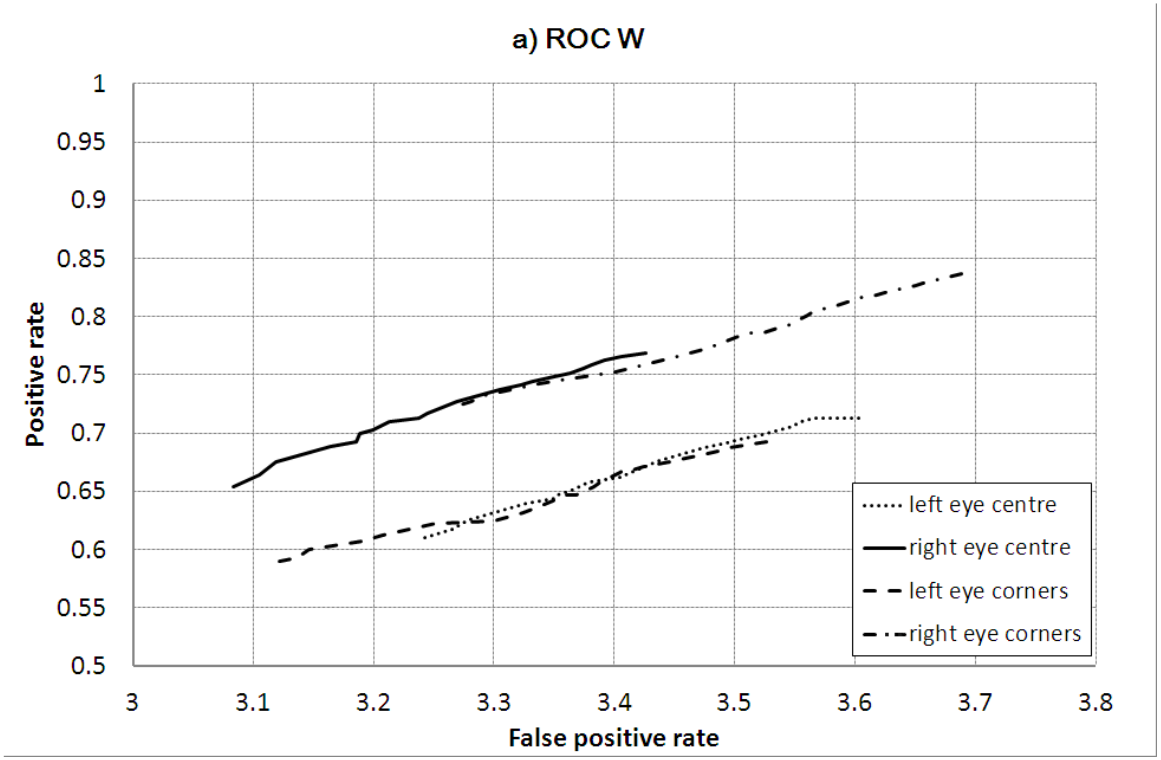
Experiments



Results


a) ROC W
Positive rate
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
3
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
False positive rate
left eye centre
right eye centre
left eye corners
right eye corners

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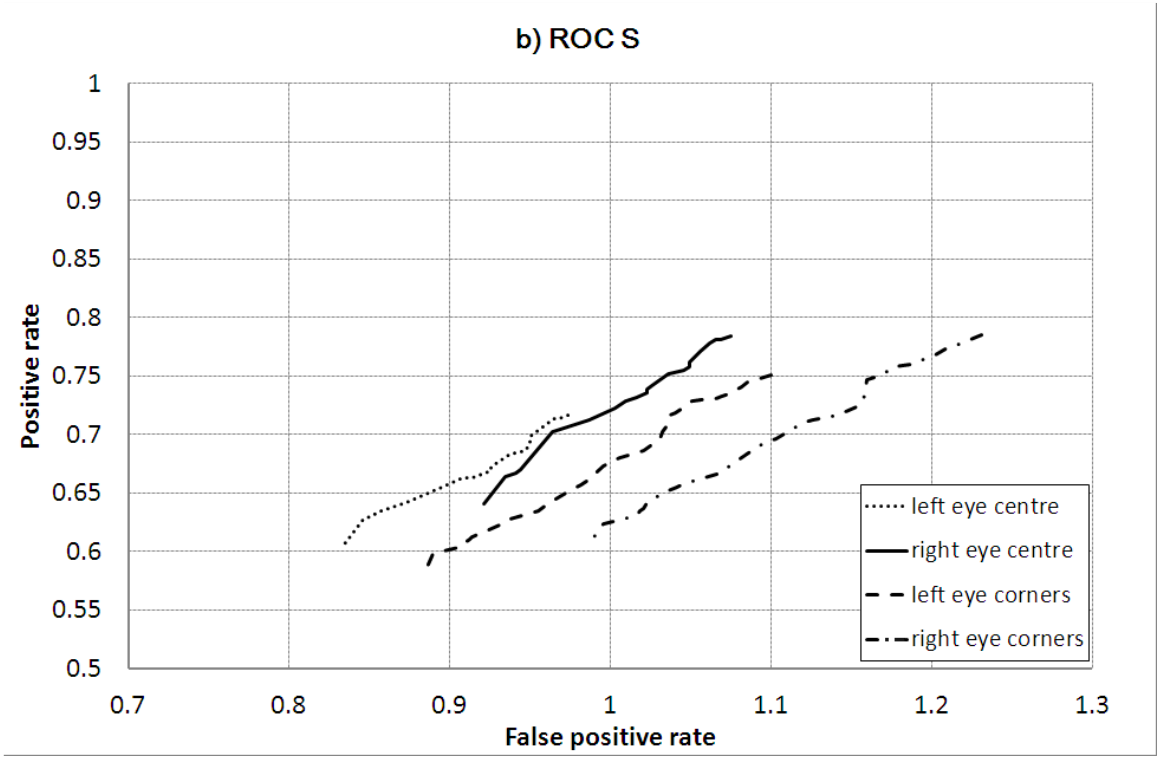
Results



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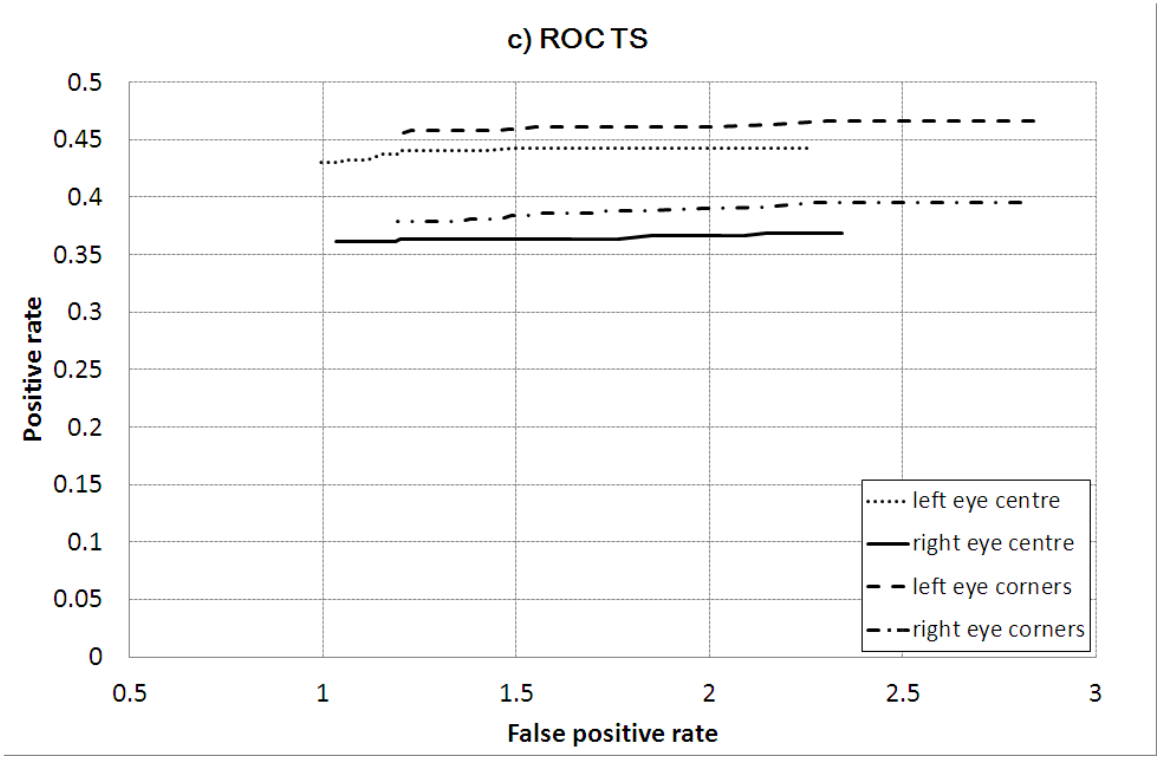
Results



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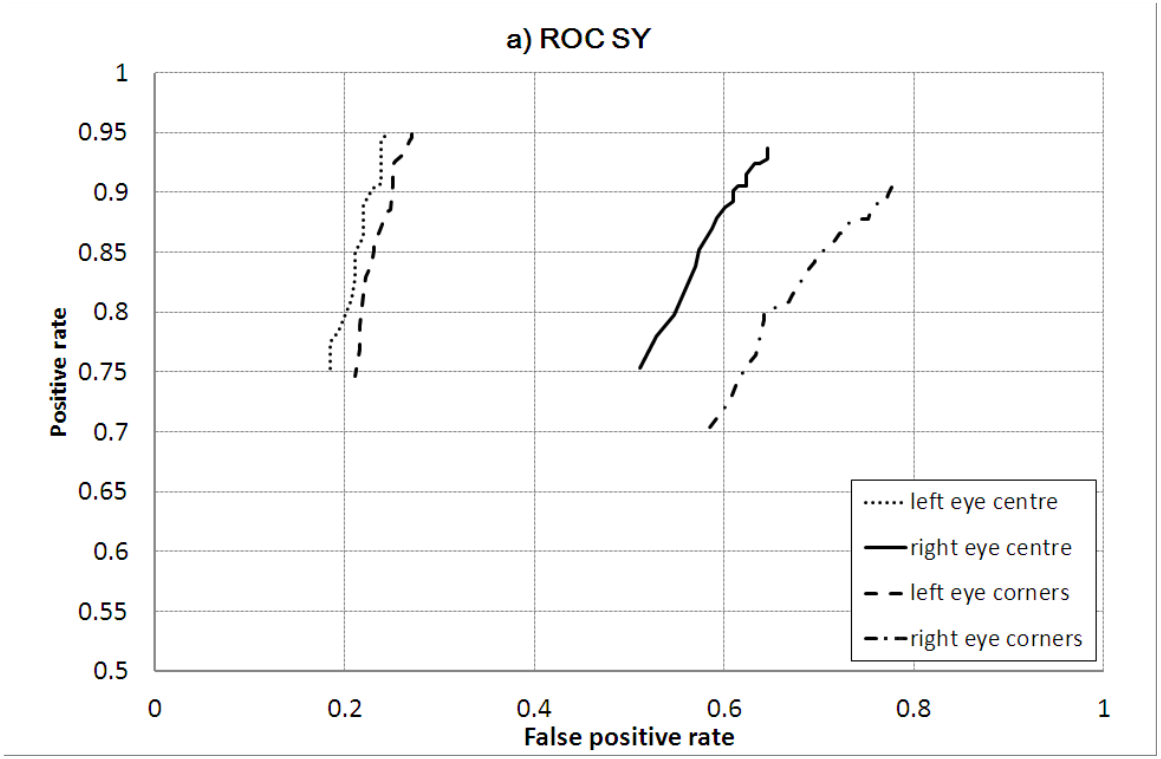
Results



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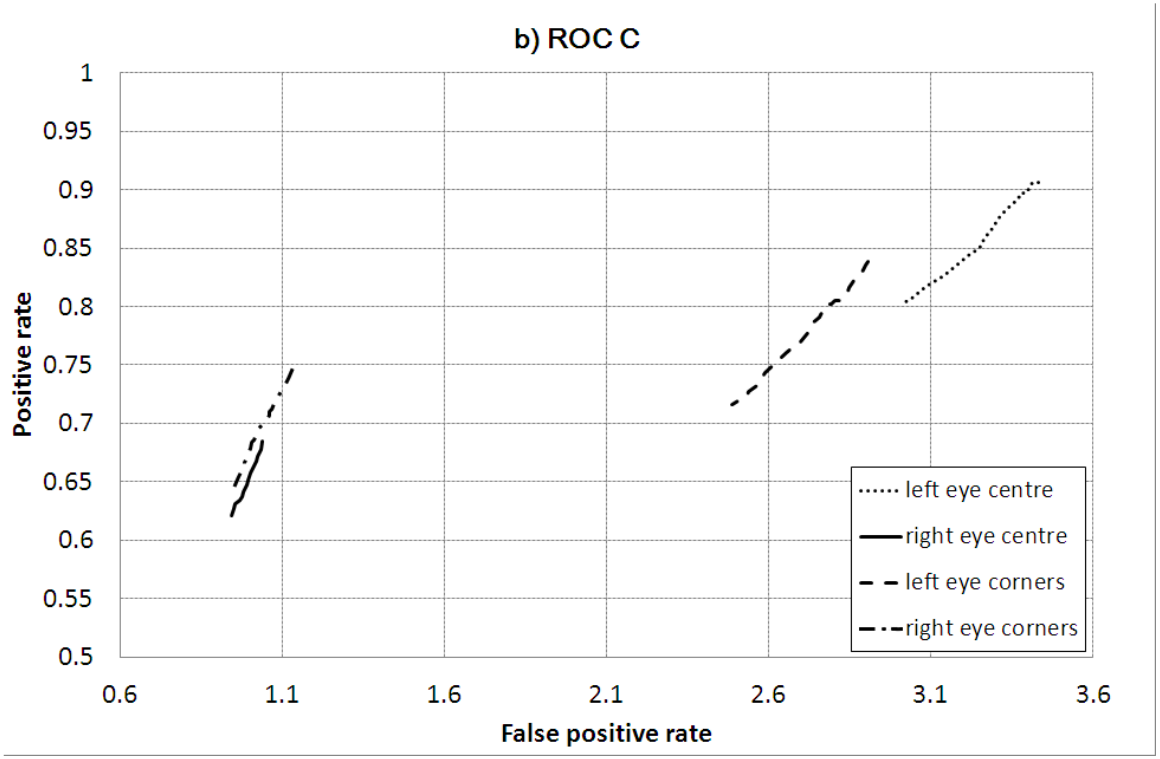
Results



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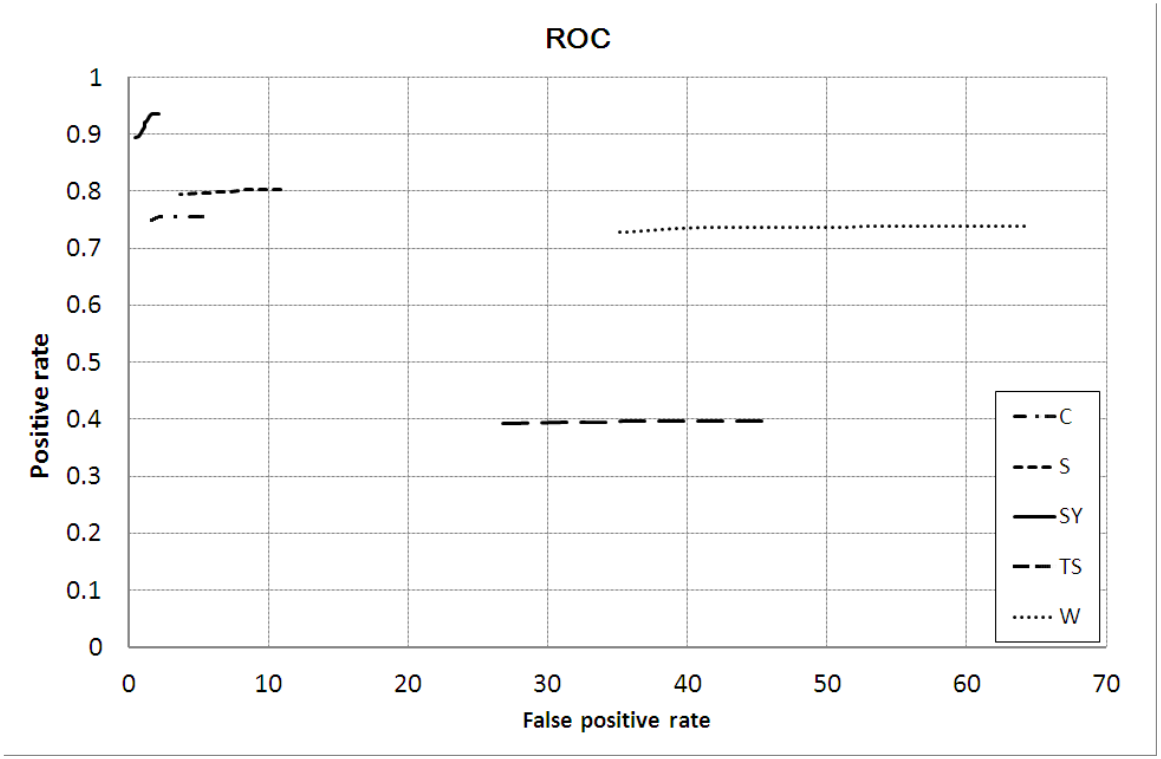
Results



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Conclusions

- Gi4E dataset provides images of subjects with gaze orientation rotations in low resolution.
- Using Gi4E the performance of the different eye detectors available has been tested.
- Classifiers specifically trained to detect one eye (right or left) are influenced by the orientation of the eyes, whereas they have a better overall performance than the classifiers trained to detect both eyes indistinctly.
- The new Gi4E evaluation dataset has proved to be a fair and useful evaluation tool for eye detection and gaze tracking low cost applications

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