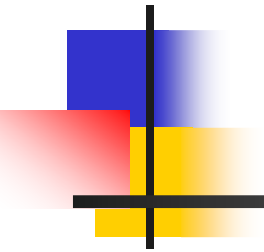

IMPROVED IDENTIFICATION OF IRIS AND EYELASH FEATURES

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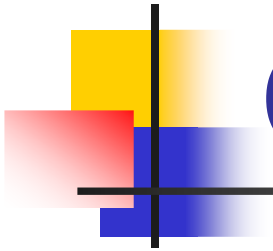
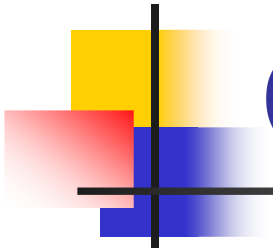
Carleton University,
Ottawa, Ontario
June 26, 2008



Outline

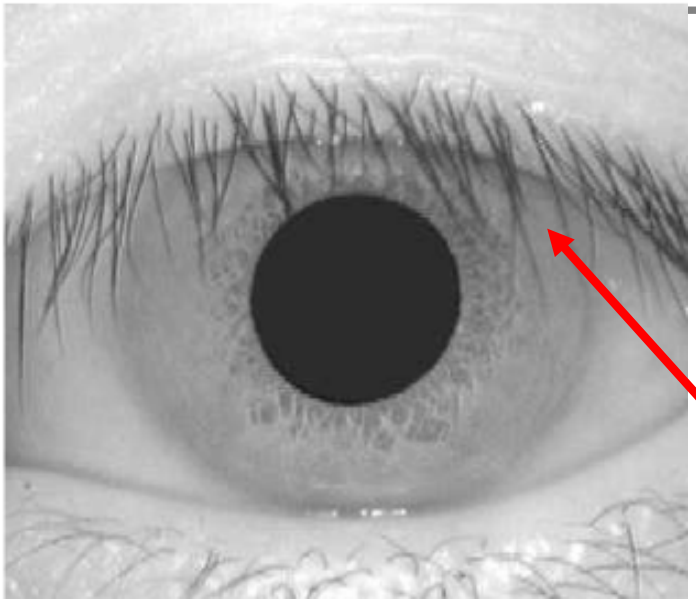
- Introduction
  - Problem definition
- Algorithm design
  - Pupil-Iris region localization
  - Boundary extraction
  - Eyelash detection (separable and multiple eyelashes)
- Results
- Concluding Remarks



Contributions and applications

- Proper iris segmentation is essential for various security applications using iris recognition technology for personal identification
- Inaccurate detection of these occlusions reduces considerably the performance of an iris-based identification system when subject cooperation is not possible
- Exact eyelash detection and segmentation is required to improve the entire biometrics system’s accuracy and avoiding poor recognition performance

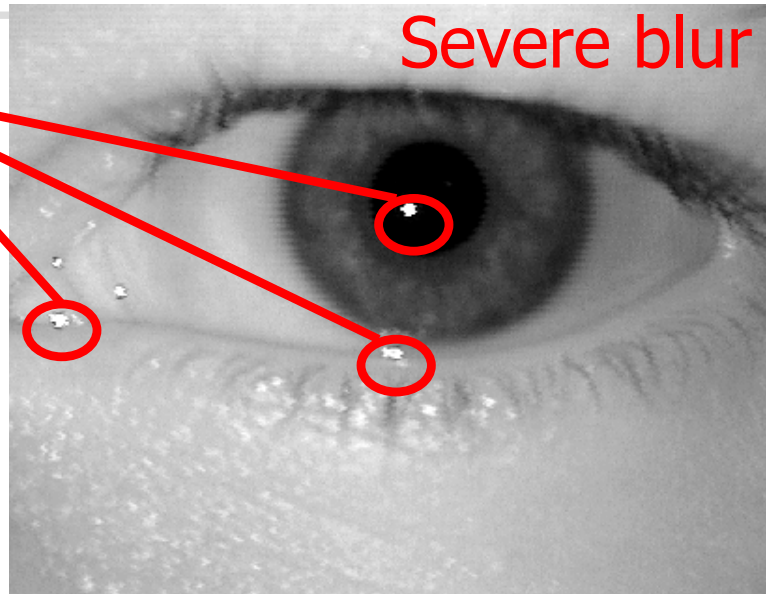
Some Challenges encountered in eye images



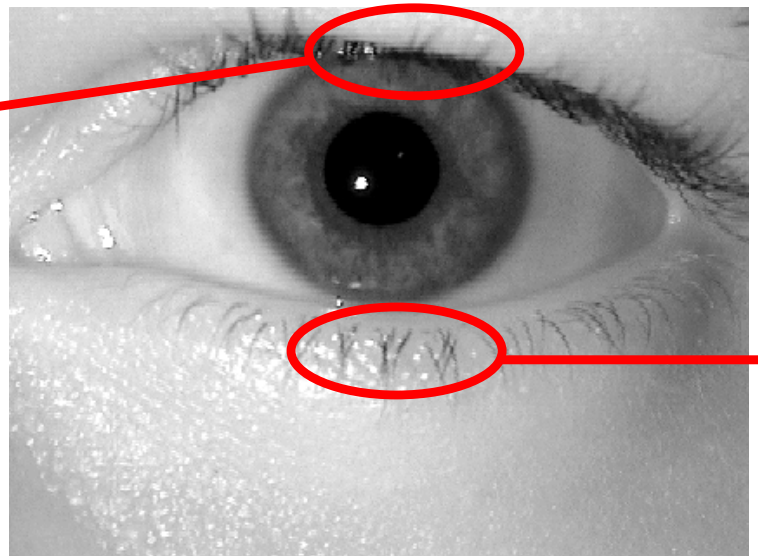
Occluded iris

Specular reflections

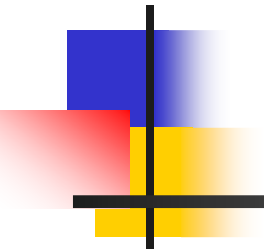
Severe blur



Multiple eyelashes



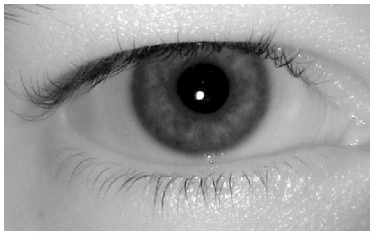
Separable eyelashes

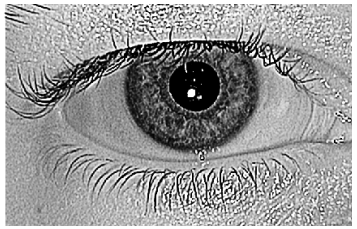


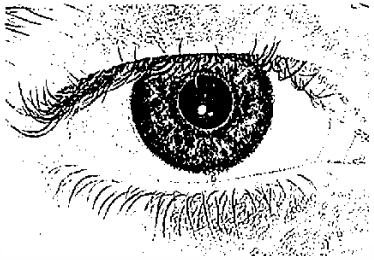
Algorithm Design
Step 1

Iris segmentation

Step 1: Iris segmentation







Original image

Non-linear image enhancement

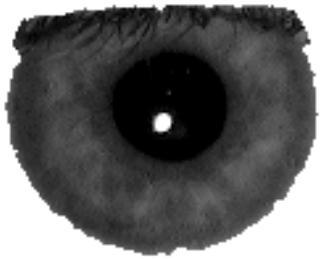
Image Binarization

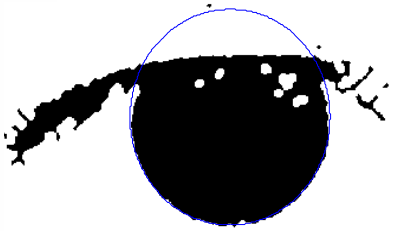
Edge Detection

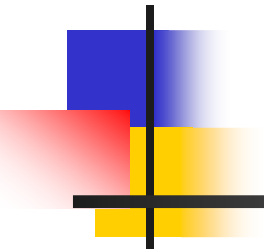
Hough Transform

Iris-pupil localization

Iris segmentation



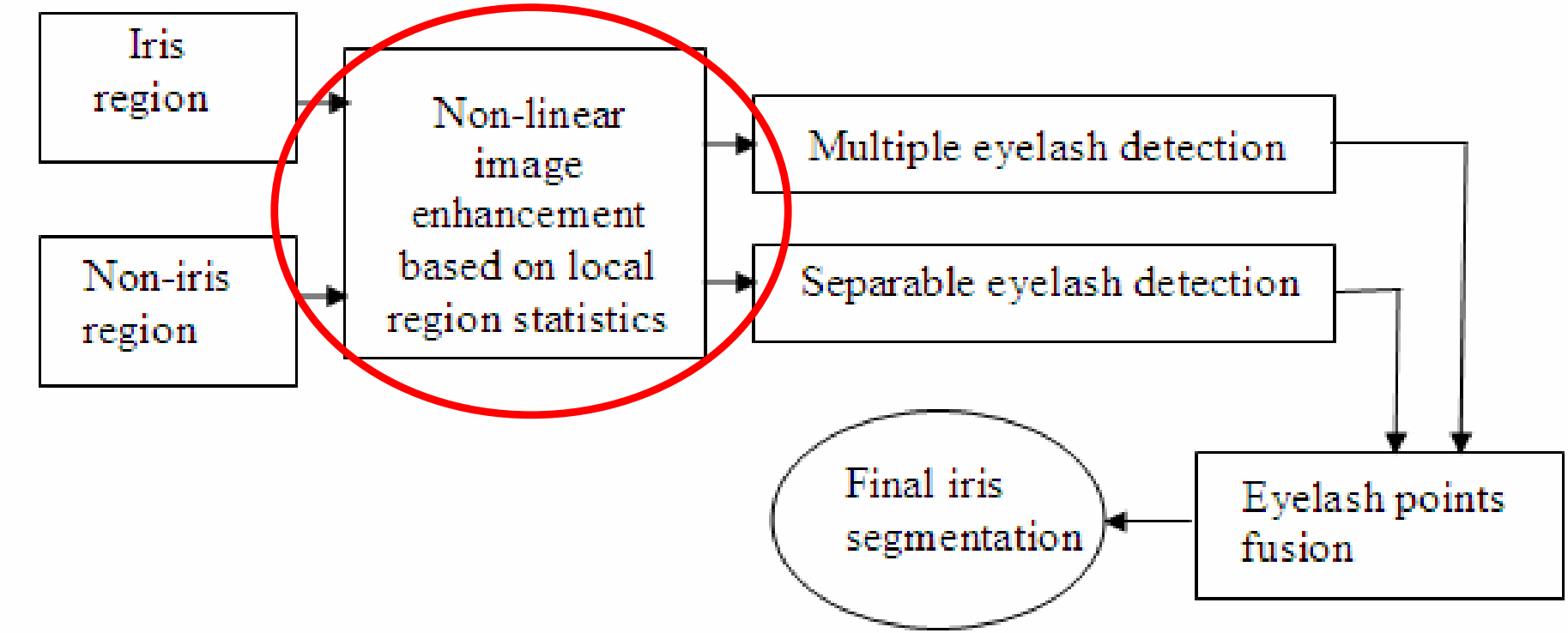




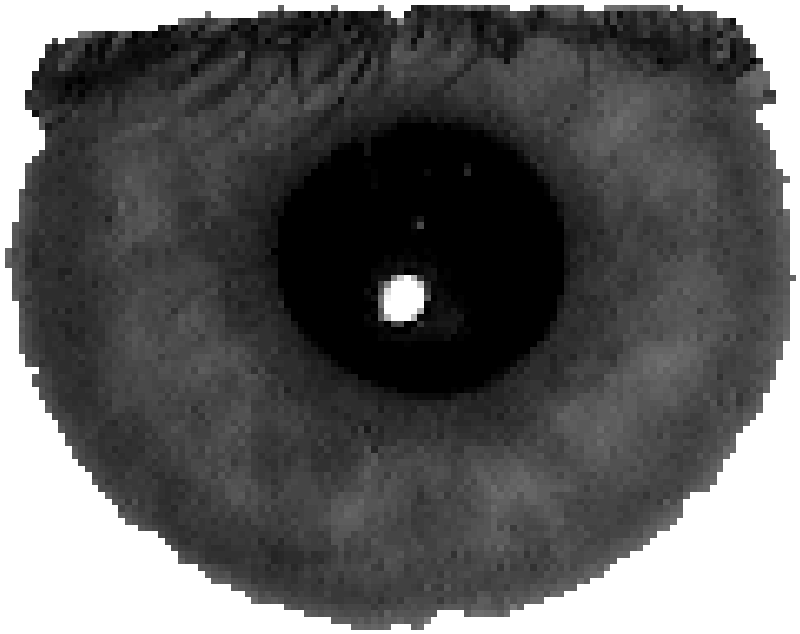
Algorithm Design
Step 2

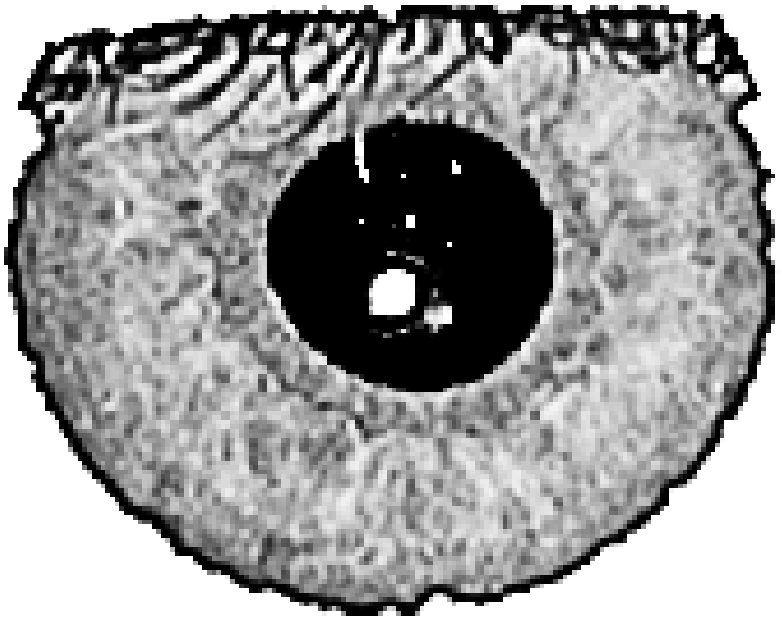
Eyelash detection using local image statistics

Step 2: Eyelash detection

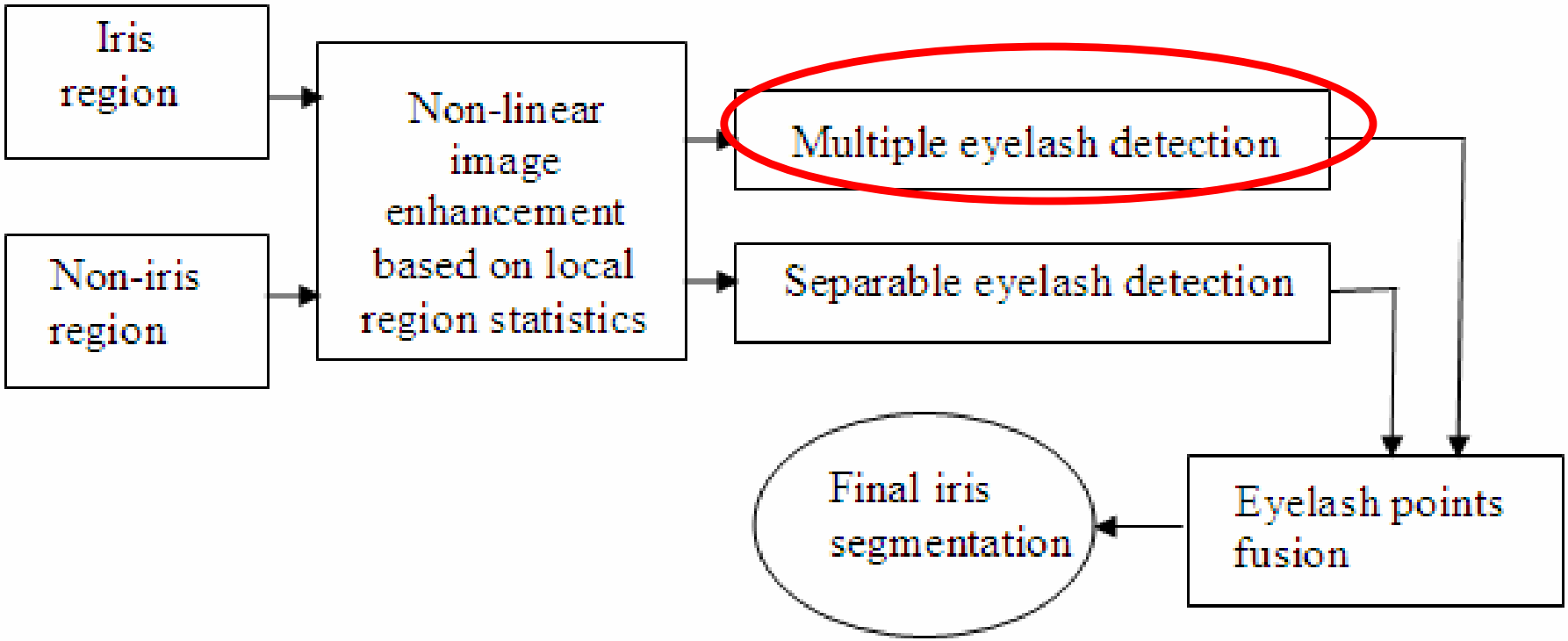


NL fine image enhancement





Eyelash detection (cont'd)



Multiple eyelash detection

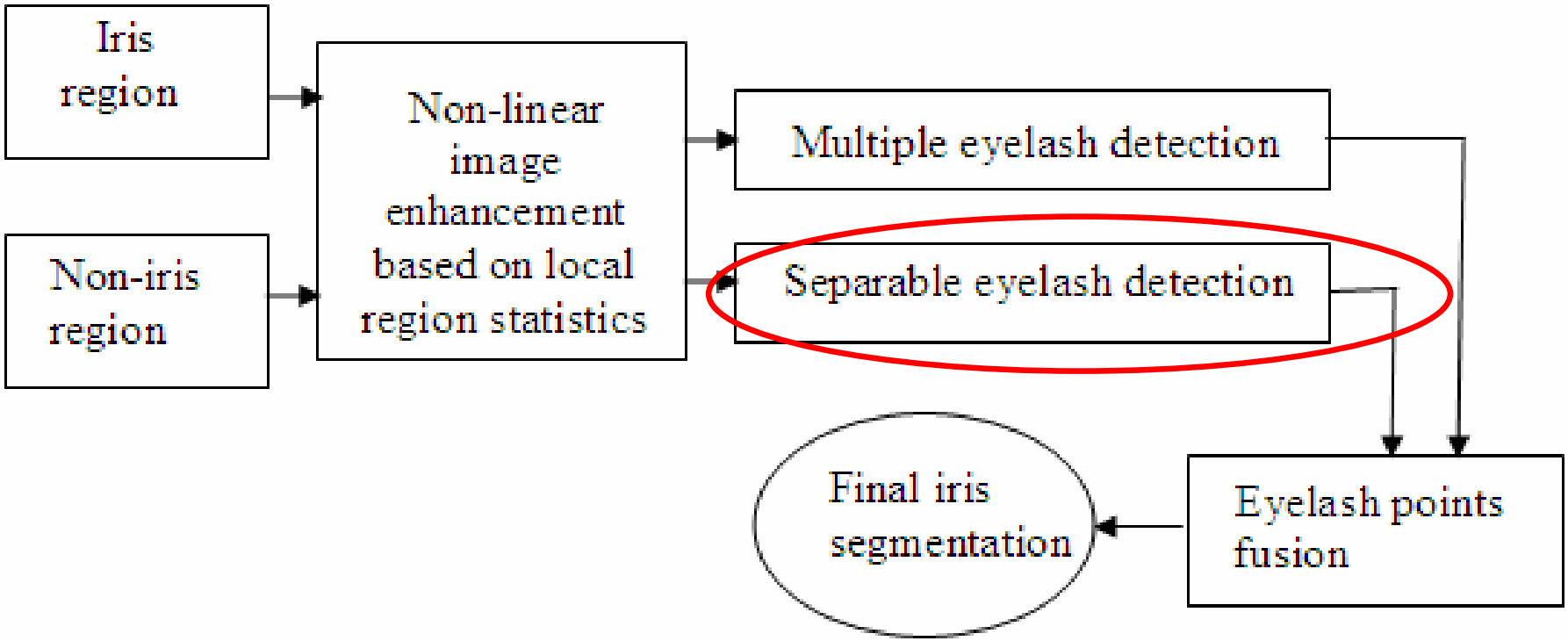
- The block mean and variance of a region are used to detect eyelash candidates.

$$u_{bi}(x,y) = \frac{1}{n^2}\sum_{i=-n}^{n}\sum_{j=-n}^{n} f(x+i, y+j)$$

$$v_{bi}(x,y) = \frac{1}{n^2}\sum_{i=-n}^{n}\sum_{j=-n}^{n} (f(x+i, y+j) - u_{bi}(x,y))^2$$

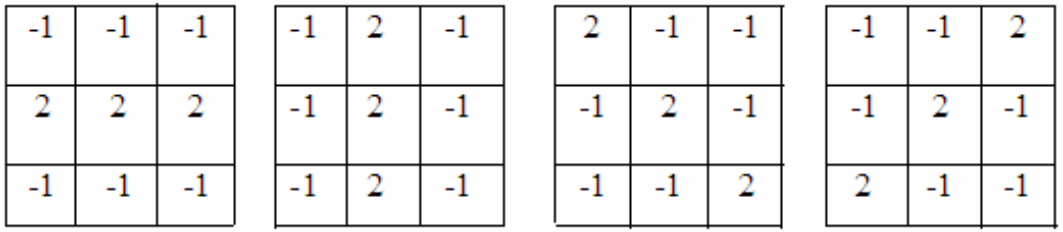
- These regions are generally composed of lower intensity pixels with a higher variance.
- The computed block mean and variance are compared to different thresholds in order to identify eyelash points.

Eyelash detection (cont'd)



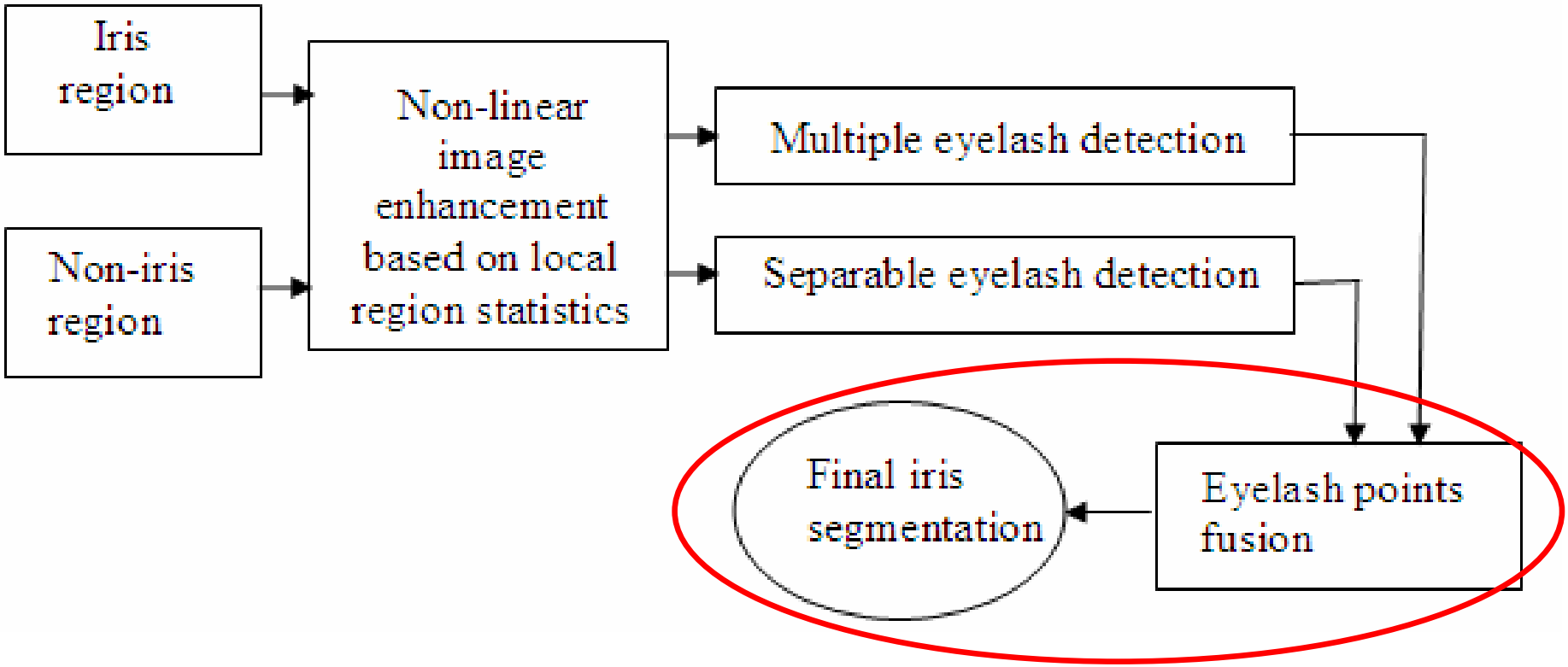
Separable eyelashes

- The enhanced image is convoluted with the developed masks.

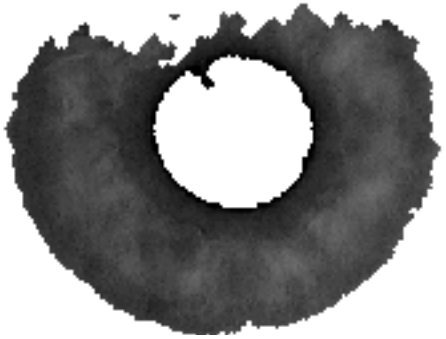


$$R_i(x,y) = \sum_{m=-N}^{N} \sum_{n=-N}^{N} I(x-m, y-n)\, M(m,n)$$

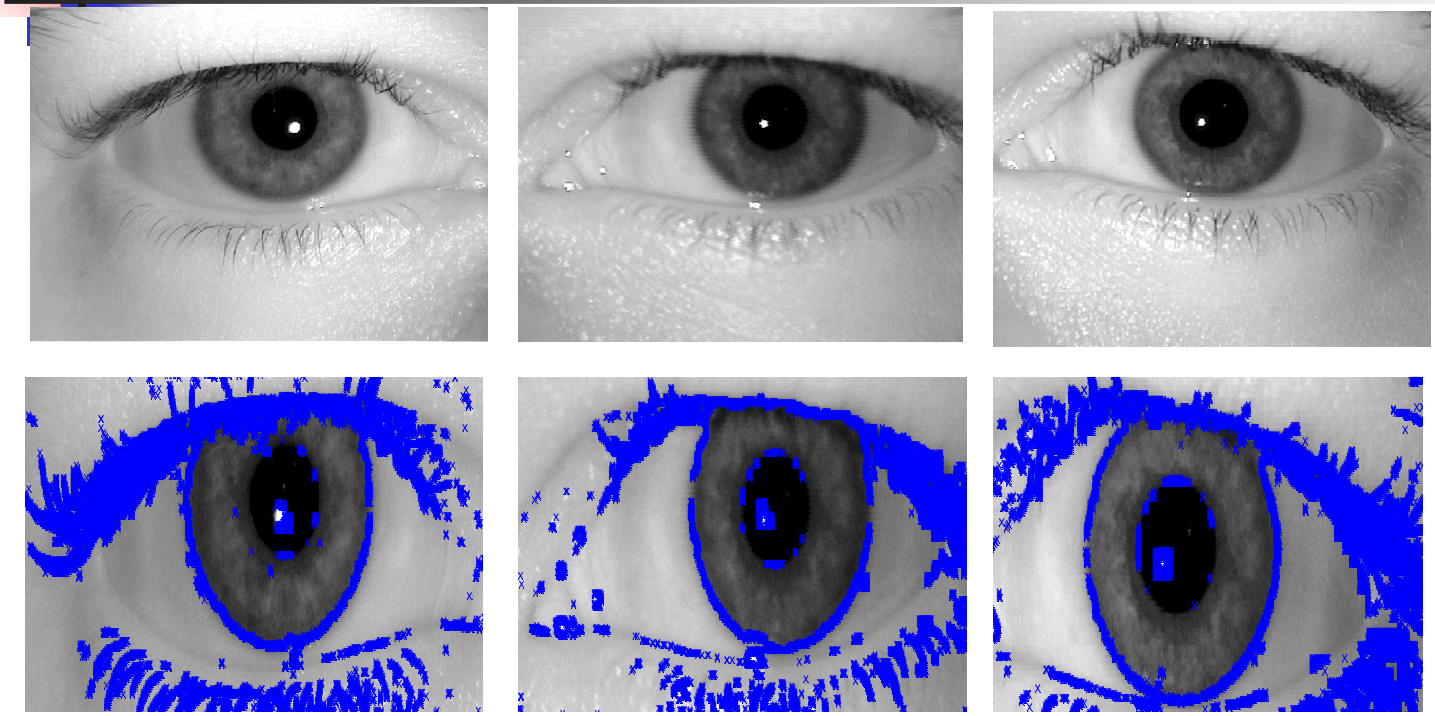
- An image with all possible eyelash points is created.
- A possible eyelash candidate point is set to "0" when the mask response is negative and to "1", otherwise.


Iris region
Non-iris region
Non-linear image enhancement based on local region statistics
Multiple eyelash detection
Separable eyelash detection
Eyelash points fusion
Final iris segmentation

Final iris region

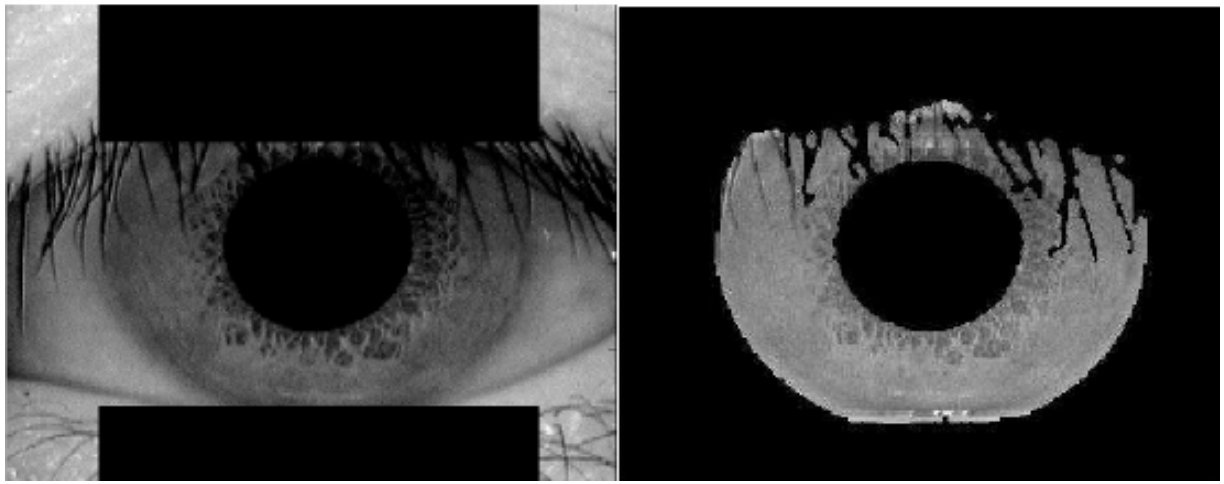


Results



Experimental results

- We used our technique prior to Daugman's iris recognition system in order to have enhanced eyelash detection before the matching process.



Regular **Enhanced segmentation**

- After testing on 327 low resolution images from the CASIA database, it is shown that the identification rate improved from 93.67% to 95.25%

Conclusion

- The proposed algorithm shows promising results for eyelash noise detection, accurate iris boundary extraction and ideal iris segmentation.
- This algorithm locates the iris boundary, extracts the exact iris contour, detects eyelash based on the local image statistics and block intensity and finally, proposes an ideal iris model for accurate iris recognition.

Thank you

References

- [1] Y. Wang, Y. Zhu and T. Tan, "Personal Identification Based on Iris Recognition", Acta Automatica Sinica, vol. 28, 2002, 1-10.
- [2] W.K Kong and D. Zhang, "Accurate Iris Segmentation Based on Novel Reflection and Eyelash Detection Model", Proceedings of International Symposium on Intelligent Multimedia, Video and Speech Processing, Hong Kong, 2001, pp. 263-266.
- [3] J. Huang, Y. Wang, T. Tan and J. Cui, "A New Iris Segmentation Method for Recognition", Proceedings of the 17th International Conference on Pattern Recognition, 2004,1051-4651.
- [4] X. Yuan and P. Shi, "An Iris Segmentation Procedure for Iris Recognition", Sinobiometrics, 2004, pp. 546-553.