

# Symmetry-Based Eye Detection in Facial Images Using Hough Transform for Circles

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## INTRODUCTION & AIM

Eye detection is critical in a variety of applications, ranging from facial recognition in human-computer interfaces to the analysis of human behavior and disease diagnosis. Scientific literature highlights the eyes as the most significant feature of the face, prompting extensive research in eye detection.

Given the iris region's circular nature, the Hough Transform for Circles (HTC) emerges as a promising technique for identifying eyes. Utilizing the parametric equation of a circle, the HTC facilitates eye location through the template matching method. Moreover, HTC offers a non-invasive alternative to active approaches such as infrared eye detection and can reconstruct image shapes even with information loss due to digital processing.

This study aims to apply HTC for detecting eyes on human faces.

## METHOD

Digital processing was conducted on 30 resized images (200x233) sourced from a public database. During the detection stage, code was implemented to derive the Hough space and recognize circles. An eye pair detector was then developed using the coordinates of the centers and radii of the circles identified by the Hough Transform. Finally, pairs of eyes were detected on various male and female faces.

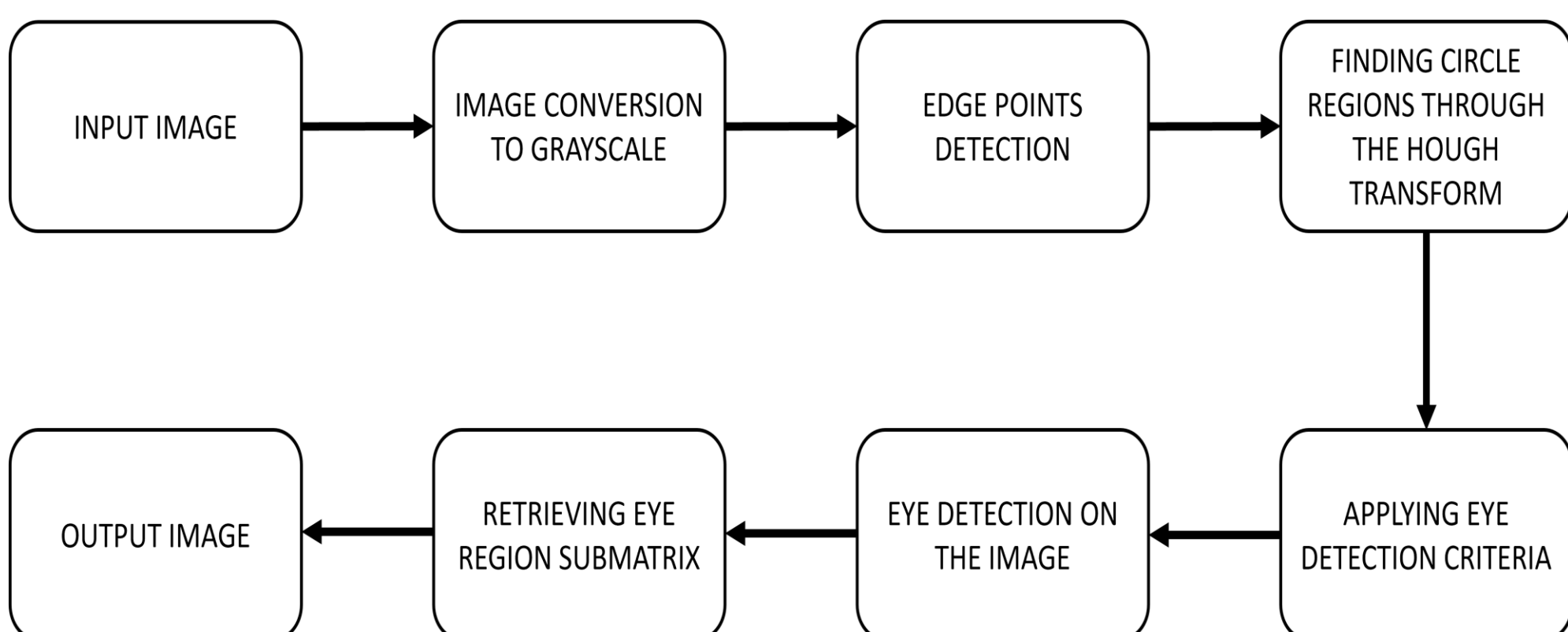


Fig 1: Block diagram of executed experimental procedures.

## RESULTS & DISCUSSION

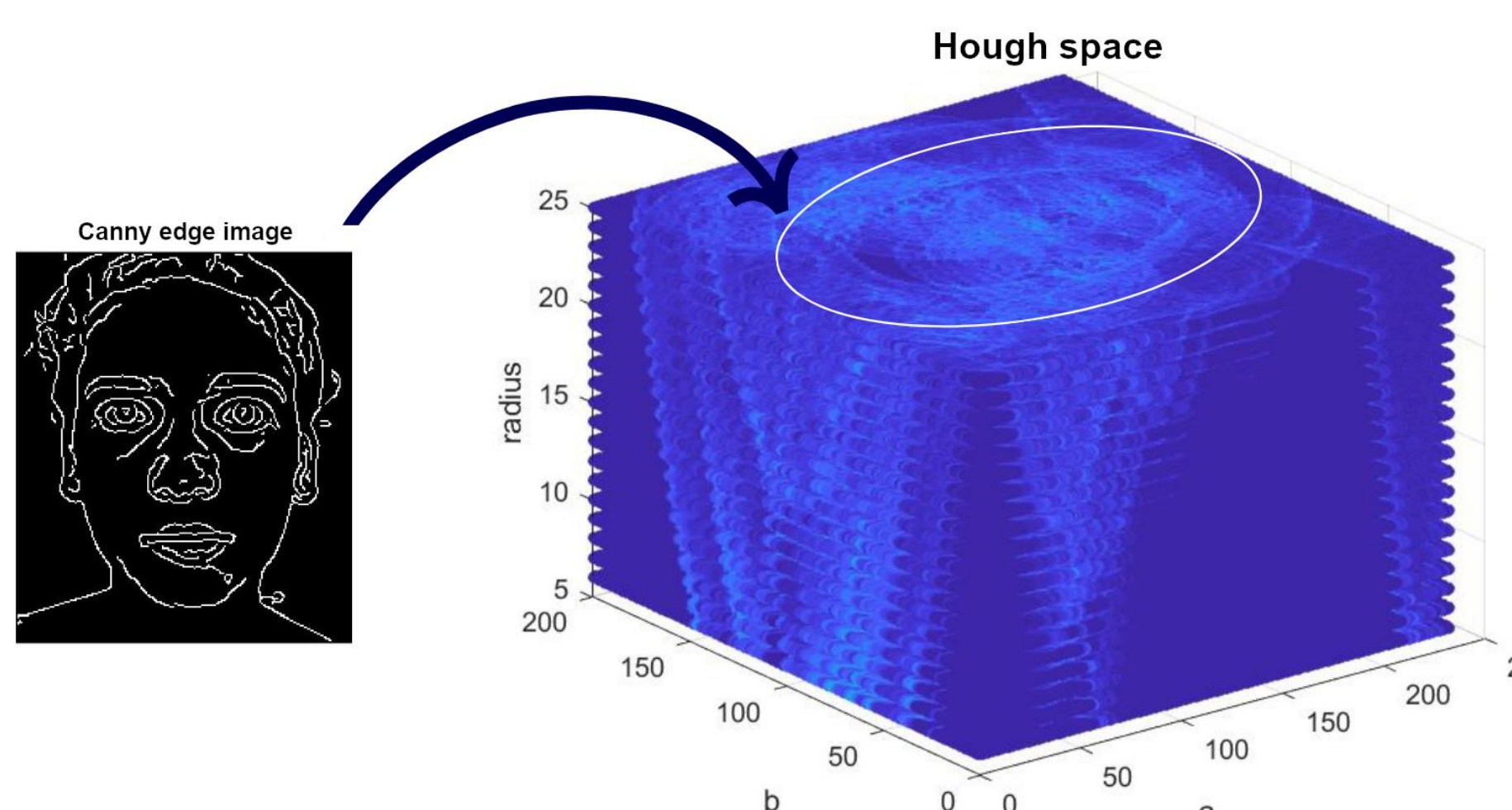


Fig. 2: Hough space obtained through the executed eye detection.

### • Eye detection criteria:

- Minimum and maximum radius variation;
- Hough threshold;



**CONCLUSION: INSUFICIENT CRITERIA  
TOO MANY CIRCLES WERE DETECTED**

### • Eye detection criteria:

- Minimum and maximum radius variation;
- Hough threshold;
- Symmetry



**CONCLUSION: EYES DETECTED  
REGION SUBMATRIX GENERATED**

C



Fig. 3. (A): Experiments executed using 80% as threshold of maximum points. (B): Obtained results for eye shape and related face region detection. (C): Experiment was executed with men and women faces wearing glasses or not.

## CONCLUSION

The findings indicate that it is feasible to non-invasively detect the eye region on human faces using the Hough Circles Transform. By incorporating the analysis of facial symmetry, specifically the interocular distance, HTC can reliably identify the eye region.

## FUTURE WORK / REFERENCES

Future work will focus on using the submatrix of the image corresponding to the eye region as input for eye tracking

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