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## Classification of Body Constitution Based on TCM Philosophy and Deep Learning

Muhammad Saqlain Aslam Ph.D., Supervisor: Yung-Hui Li

Department of Computer Science and Information Engineering, National Central University

### Abstract

In this study, we proposed a real-time, non-invasive, and painless technique to assess an individual's health condition. Our approach is based on the combination of iridology and the philosophy of traditional Chinese medicine (TCM). The iridology chart presents perfect symmetry between the left and right eyes, and such a unique representation reveals the body constitution based on TCM philosophy, which classifies the aforementioned body constitution into a combination of nine categories to describe the varieties of genomic traits. In addition, we applied a deep-learning method along with the combination of iridology and TCM to predict the possible physiological or psychological strength or weakness of the subjects and give advice to them about how to take care of their health according to the body constitution assessment. We used several pre-trained convolutional neural networks (CNNs), such as a residual neural network (ResNet50), InceptionV3, and dense convolutional network (DenseNet201), to classify the body constitution using iris images. In the experiments, the CASIA-Iris-Thousand database was used to perform this task. The experimental results showed that the proposed iris-based health assessment method achieved an 82.9% accuracy.

### Materials and Methods

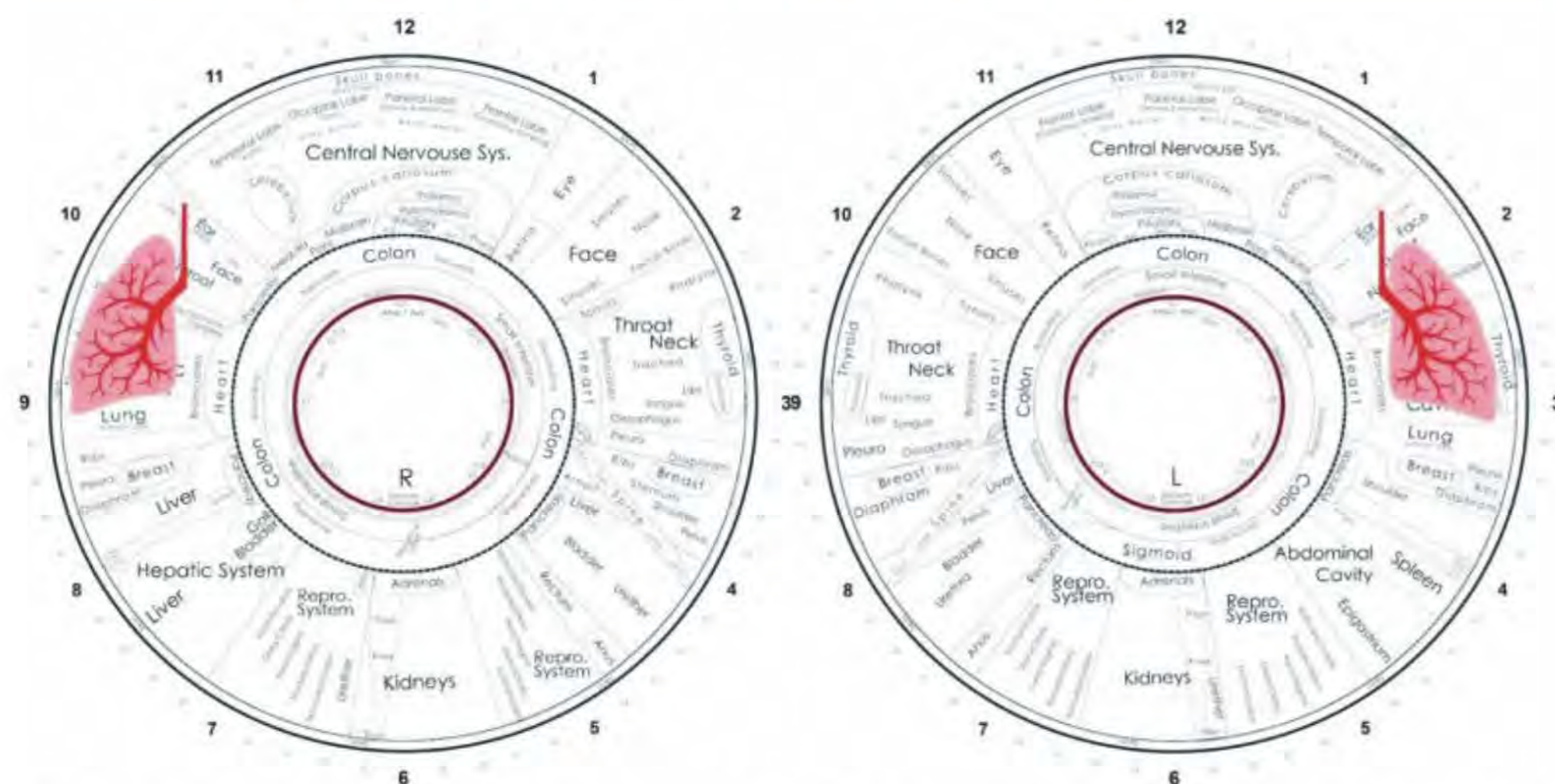


Fig. 1 Iridology chart is shown for both the right and left iris and their relations to body organs.

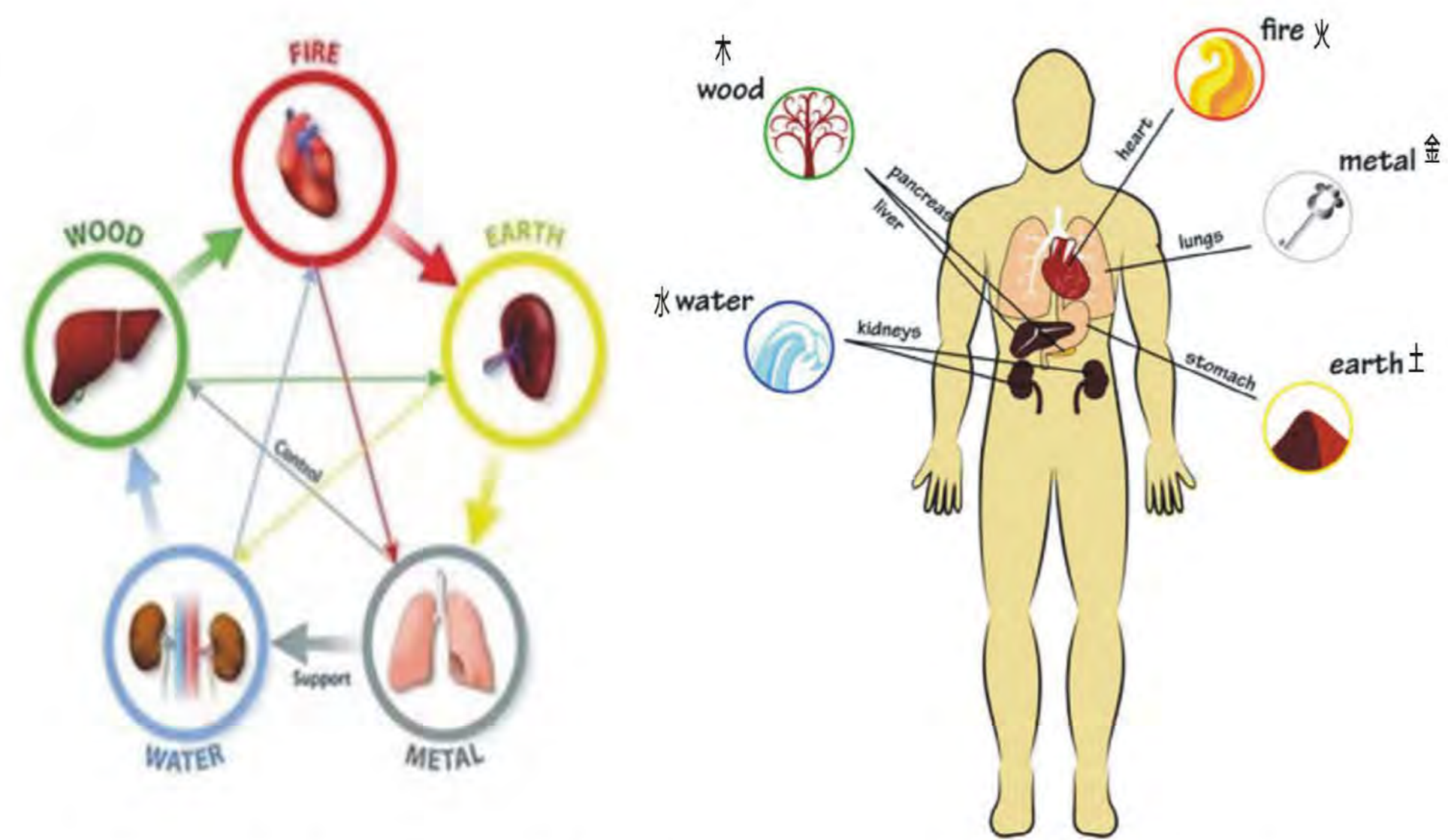


Fig. 2 Classification of body constitution according to TCM theory.

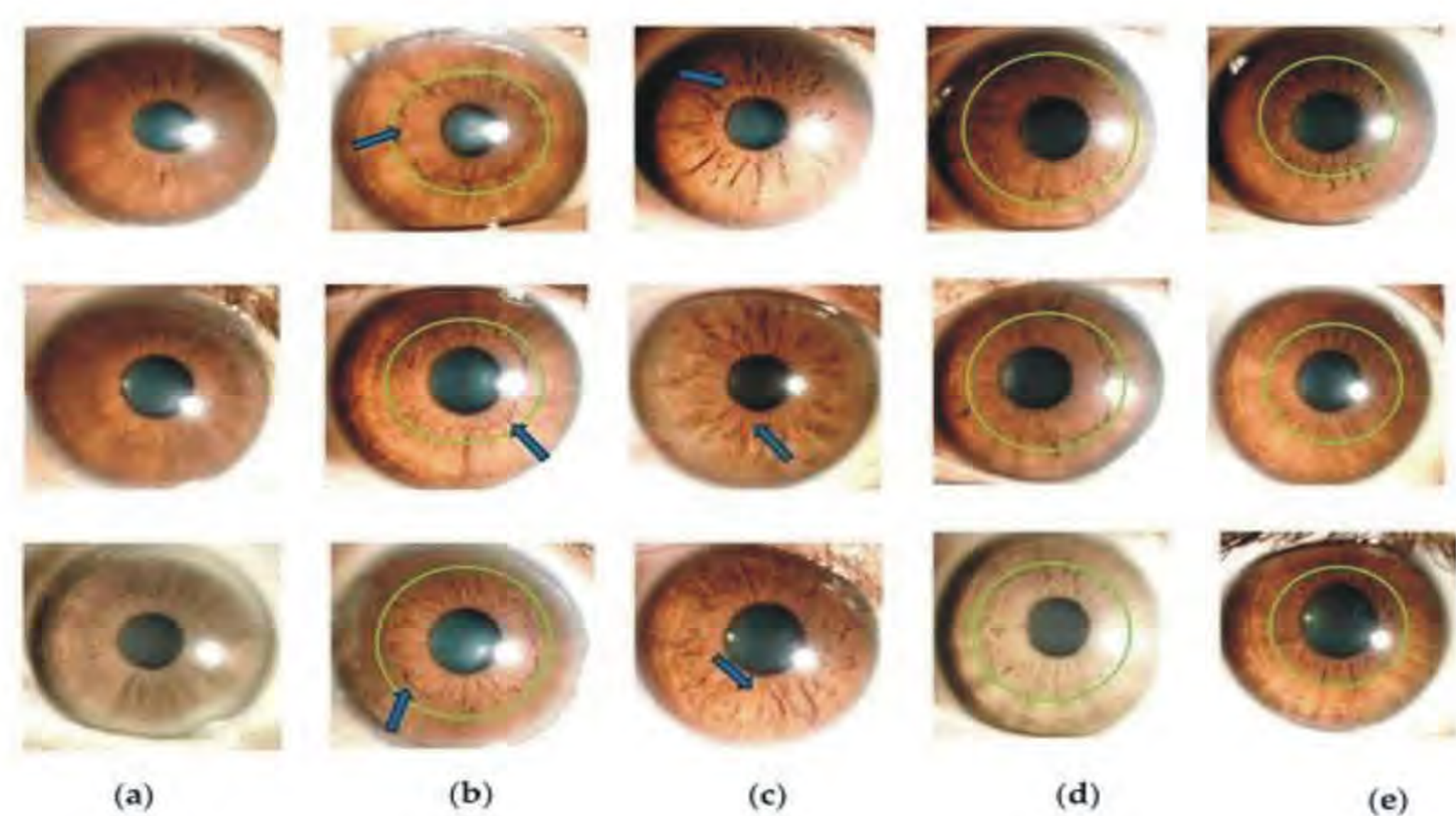


Fig. 3 Samples of iris images based on the third ring of iris. (a) Wood type iris (b) Water type (c) Metal type (d) Earth type (e) Fire type iris image.

Table. 1 Classification of five body constitution based on the third ring of the iris chart.

TCM Elements	Ring Shape
Wood	It has no explicit ring pattern.
Water	It has an explicit ring pattern and very small acute angles.
Metal	It has acute angles around itself.
Earth	Its radius is bigger than the radius of 1/3 iris.
Fire	Its radius is smaller than the radius of 1/3 iris.

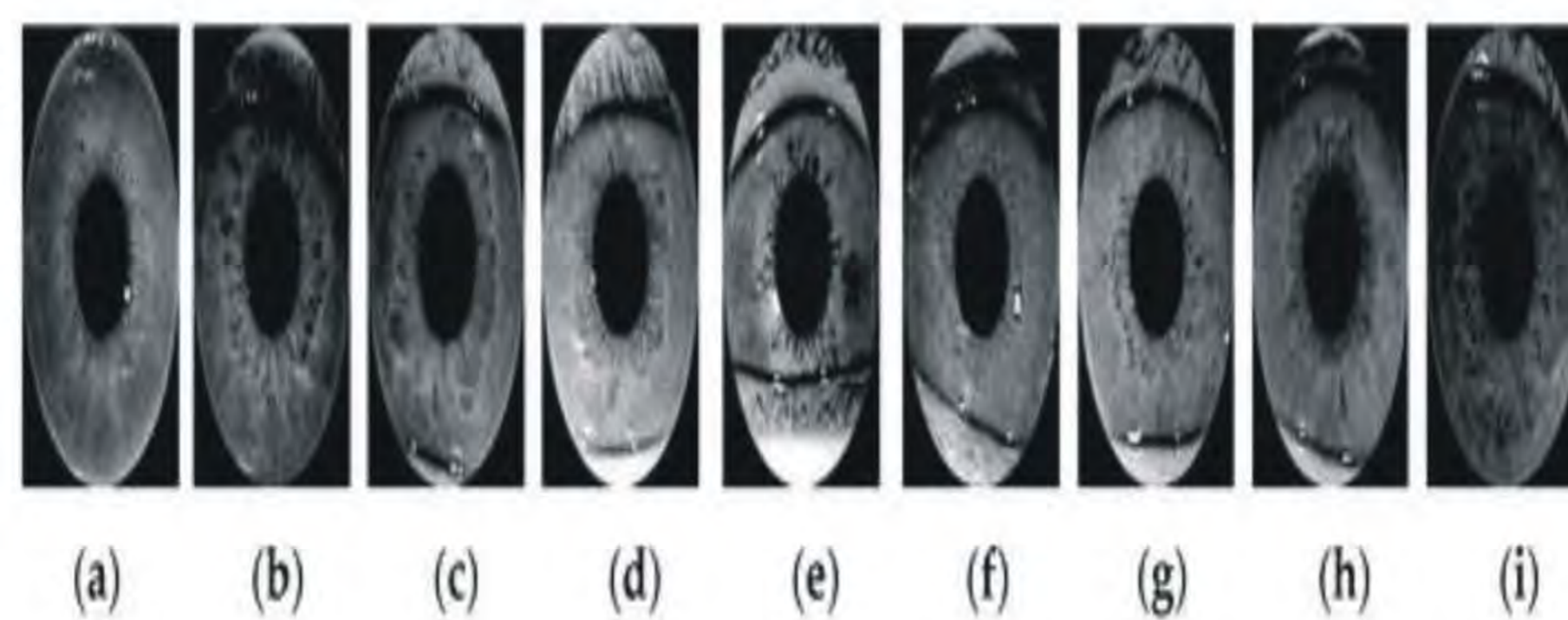


Fig. 4 Samples of iris images of the derived nine categories. (a) Fire and Wood (b) Earth and Metal (c) Earth and Water (d) Earth and Wood (e) Fire and Metal (f) Fire and Water (g) Metal and water (h) Water and Wood (i) Wood and Metal.

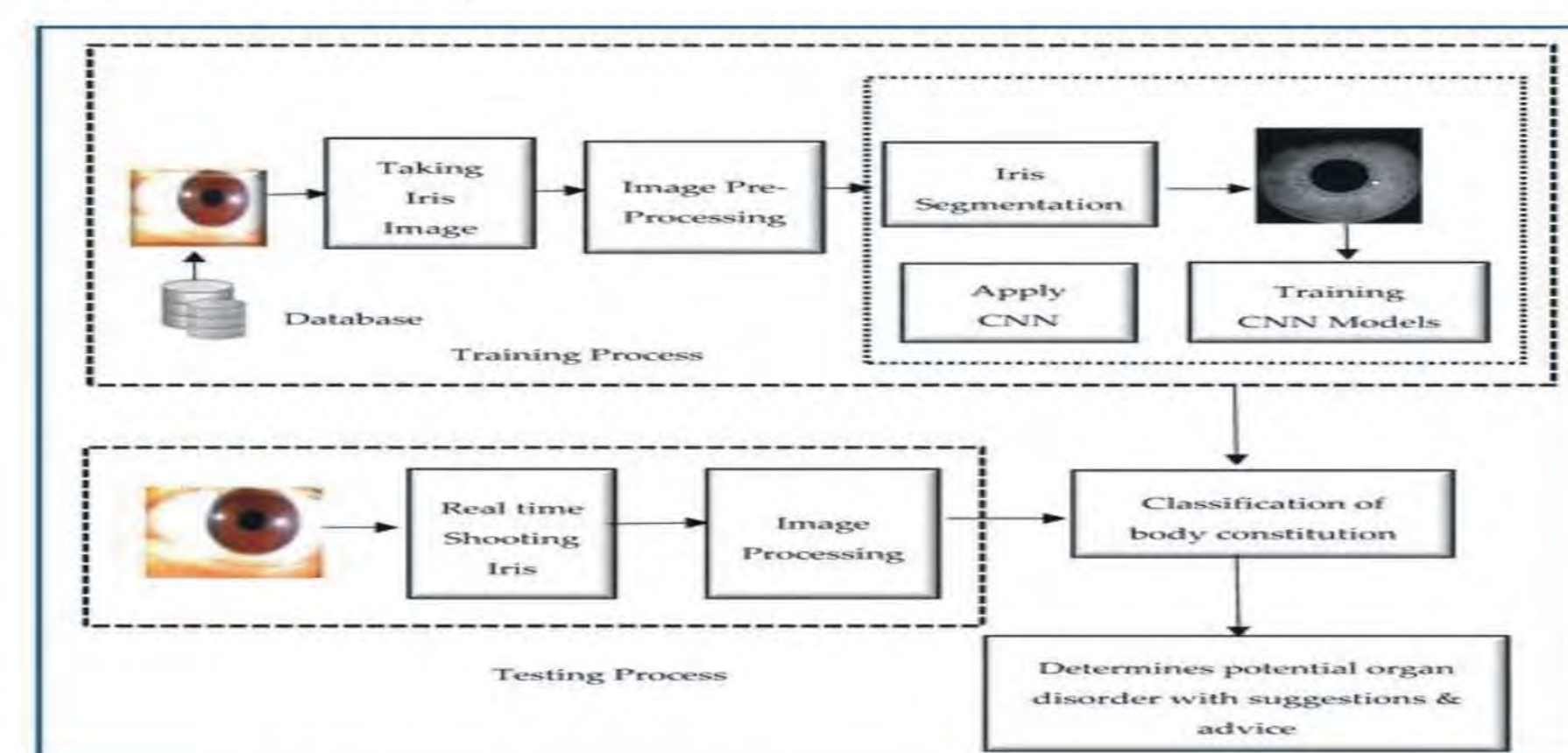


Fig. 5 Flowchart of the proposed iris-based health assessment system.

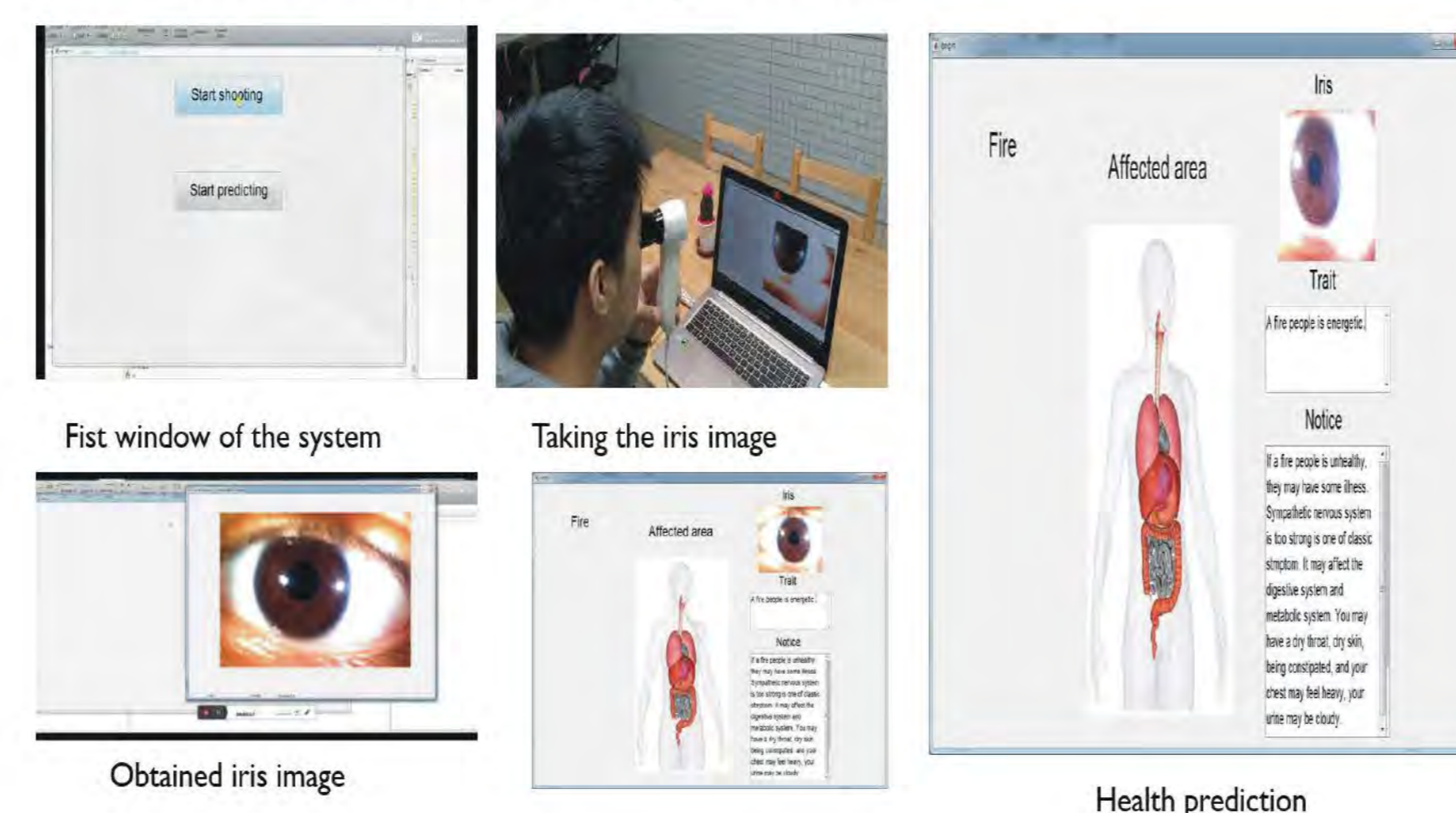


Fig. 6 System Real-Time Demo.

### Experimental Results

Table. 2 Performance of the CNN models.

Models	Mean Accuracy %
ResNet50	79.5
InceptionV3	77.5
DenseNet201	82.9

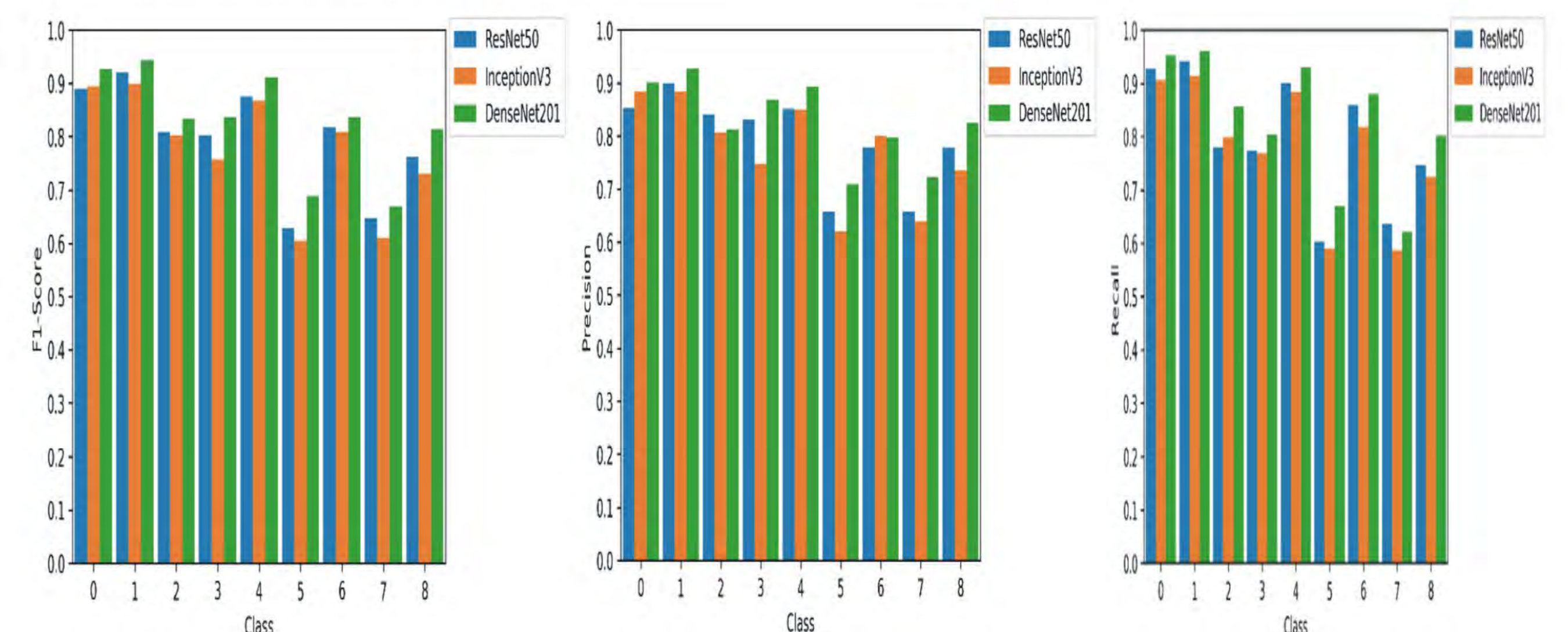


Fig. 7 Precision, recall and F1 score of all three models.

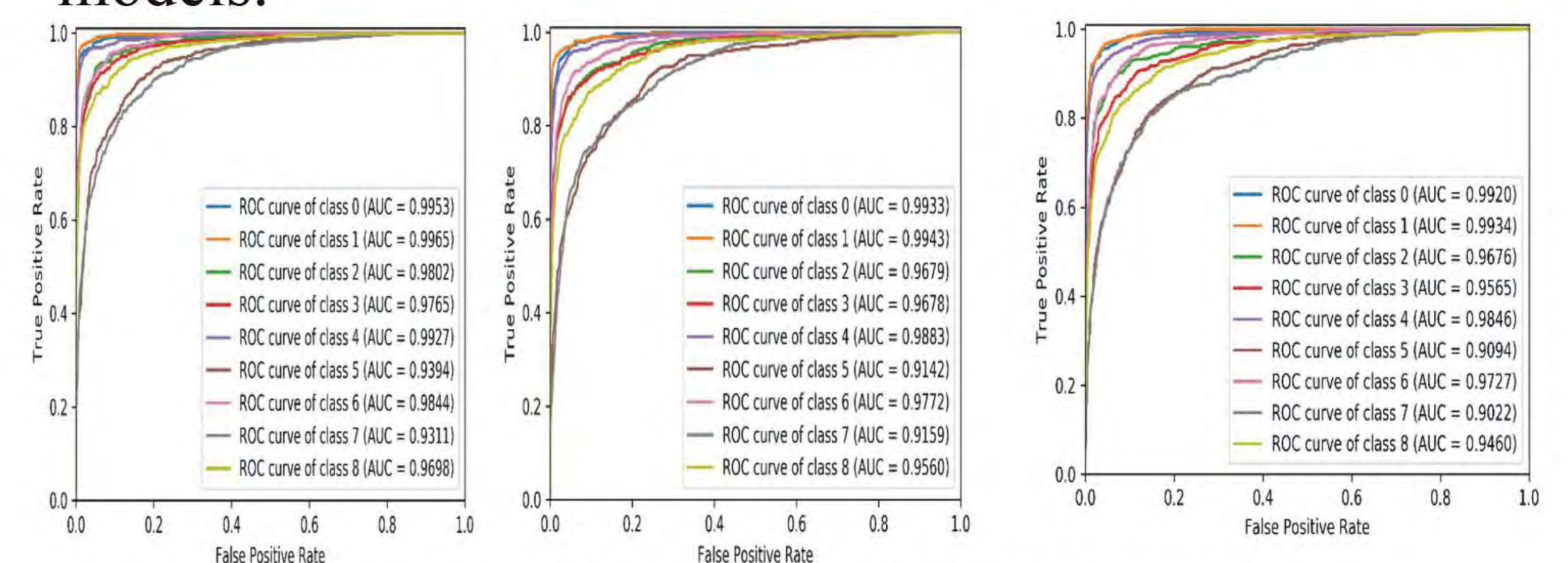


Fig. 8 ROC curve of DenseNet201, Inception V3 and ResNet502.

### Summary

This paper makes the following contributions:

- We built the first largest scale iridology database using CASIA-Iris-Thousand.
- The powerful DL model was applied to perform body constitution classification and was able to achieve a very high accuracy.
- A practically proven system was built, which can work in a real-time environment.

### Selected Publications

- Li, Y.H., Aslam, M.S., Yang, K.L., Kao, C.A. and Teng, S.Y., 2020. Classification of body constitution based on TCM philosophy and deep learning. *Symmetry*, 12(5), p.803.
- Li, Y. H., Aslam, M. S., Harfiya, L. N., & Chang, C. C. (2021). Conditional Wasserstein Generative Adversarial Networks for Rebalancing Iris Image Datasets. *IEICE TRANSACTIONS on Information and Systems*, 104(9), 1450-1458.