

# Algorithm development for wrinkle evaluation based on artificial intelligence (AI) technology

Jin Hee Shin<sup>1</sup>, Jaehyung Kim<sup>1</sup>, Gabin Ryu<sup>1</sup>, Jong-Ho Park<sup>1</sup>, Woong-gyu Jung<sup>2</sup>, Yu-jin Ahn<sup>2</sup>, Hyun-mo Yang<sup>2</sup>, Jin-Oh Park<sup>1</sup> and Hae-Kwang Lee<sup>1\*</sup>

<sup>1</sup>P&K Skin Research Center., Seoul, Republic of Korea, <sup>2</sup>Department of Biomedical Engineering, Ulsan National Institute of Science and Technology (UNIST)., Seoul, Republic of Korea

\*hklee@pnskin.com

## Abstract

The visual evaluation of wrinkles is a form in which the subjective point of view of the evaluator enter although it is broadly used in the fields of skin evaluation such as cosmetics and dermatologic research. In this study, we developed a wrinkle detection algorithm based on a AI technique. This system can accurately and rapidly detect wrinkles. Grades classified by visual assessment were used as references and we chose the control-learning method provided with the algorithm (Visual assessment vs AI evaluation). Five hundred images were submitted to a machine learning algorithm for reading. Acquired images are preprocessed by Face Mesh solution using MediaPipe platform on Google. The process provided 9 ROI from one photograph, and we have acquired consecutively five thousand ROIs based on machine learning. Data augmentation was performed through the image conversion process such as image rotation, brightness and contrast adjustment, and then we analyzed over one hundred thousand images augmented.

Out of 500 volunteers, the pick up rate for major wrinkles was 100%, although it for whole wrinkle grade was approximately 70%.

## Results

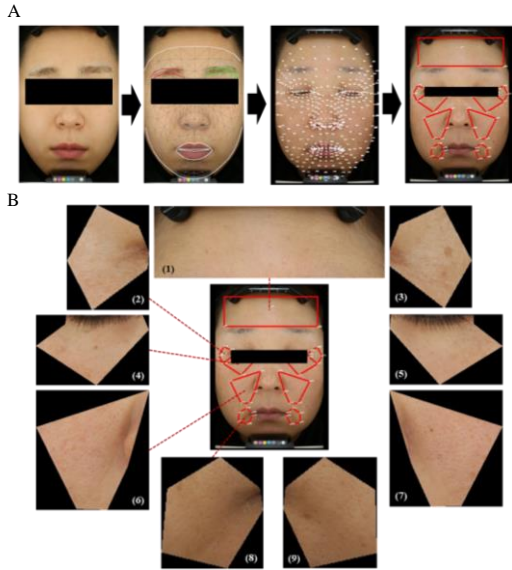


Figure 1. Pre-processing for A.I training

MediaPipe's Face Mesh solution is based on machine learning-based 3D surface shape inference, it is possible to obtain a uniform region of interest (ROI) from facial photos with various characteristics for each individual.

Grade	Description	Grade	Description
0	Essentially un wrinkled	5	A little moderate wrinkles
1	Appearing shallow wrinkles	6	Several moderate wrinkles
2	Minimal shallow wrinkles	7	Development of deep wrinkles
3	Average roughness	8	Several deep wrinkles
4	Appearing moderate wrinkles	9	Numerous large deep wrinkles

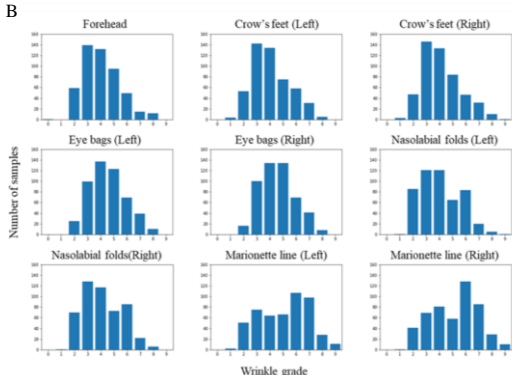


Figure 2. The distribution by visual assessment results as ROI  
Two experts evaluated the wrinkle photos of 502 subjects as visual assessment grade (A). A total of 2888 face photos were used, and among them, 4518 ROI images were used for the first AI training (B).

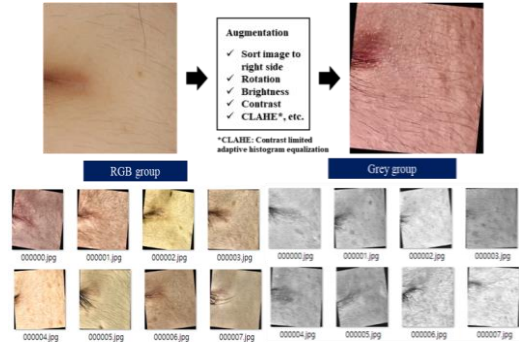


Figure 3. Data augmentation process for artificial intelligence training  
For all ROIs, 100,000 for training and 10,000 for evaluation were obtained for each class group (0-3, 4-6, 7-9) through data augmentation.

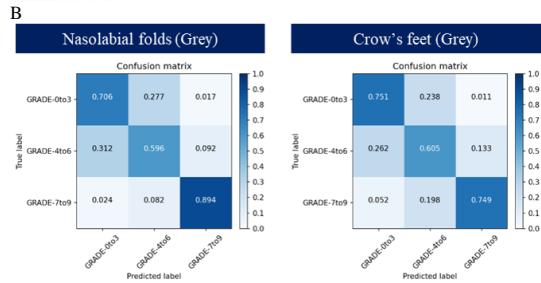


Figure 4. Grouping for deep learning  
Grade 0 to 3 were grouped into one group, grades 4 to 6 and grades 7 to 9 were grouped into one group, respectively, and the grades were reorganized and used for AI training (A). The AI model was individually trained for a total of 10 conditions, including 5 areas under the eyes, nasolabial folds, around the lips, and on the forehead for RGB and gray images (B).

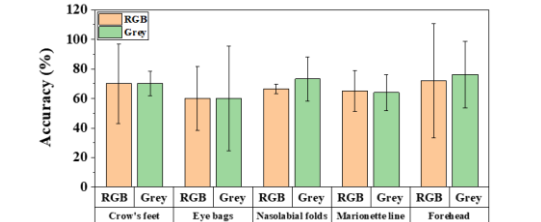


Figure 5. The accuracy of the AI model for each ROI  
As the performance result of the classification model for wrinkle around the eyes, which is one of 10 AI models

## Conclusions

In this study, we could verify that the performance AI-based wrinkle GRADE is useful and actualatable to evaluate showing efficacy results for preventing wrinkle formation by providing only images. This enables researchers to track the progress of anti-wrinkling techniques such as anti-aging cosmetics. The algorithm gives a chance to apply photographs from mobile device, showing the results similar expert grading. Moreover, our system is low cost as the wrinkle detection can be simply based on photographs.

## Acknowledgements

This project was supported by the National Research Foundation Grant (HP20C0032) funded by the Ministry of Health and Welfare.

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