Applications of Computer Vision to Posture Corrections and Eye Disease Prevention

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***Abstract*—The aim of this paper is to present a posture correction system that can be used to address childhood myopia and shoulder-neck and eye problems caused by prolonged poor posture in adults. It uses the camera on a laptop to analyze images through recognition technology. When poor posture is detected, it alerts the user via the screen and records user data. The system can improve occupational health problems caused by prolonged poor posture among many workers and assist children and adolescents during periods of rapid visual changes to reduce the trend of myopia that occurs at a younger age. After further research, this concept can also be applied to other consumer electronics products such as tablets and televisions to promote public health and well-being.**

***Keywords*—Computer Vision; Posture Corrections,; OpenCV.**

I. INTRODUCTION

In today's rapidly advancing technology landscape, most people use electronic devices such as computers daily. However, many overlook their usage patterns and the time spent on these devices. Various abnormal sitting postures and computer use [1] have led to various health problems, particularly eye problems such as myopia. Although some studies suggest that there is no significant correlation between near work and myopia, it is still beneficial to control near work time and spend more time outdoors to care for the eyes.

To address this, we recognize the importance of image recognition technology in reminding users to maintain proper postures when using electronic devices. While existing image recognition excels at basic facial and body part recognition, detecting finer details, especially in posture, remains a challenge due to the need for speed and real-time detection. Therefore, we intend to employ technologies such as deep learning and the MediaPipe [2]-[4] image recognition framework to prompt users to adopt the correct posture. Using joint points within the MediaPipe framework [5][6] and tools like OpenCV [7], our goal is to instantly recognize sitting postures and provide real-time reminders, helping improve posture and reducing the risk of eye and other health problems.

Currently, most research mainly uses fewer feature points such as the eyes, nose, and mouth for facial recognition, which can result in less precise identification. We utilize more facial landmarks recognized by MediaPipe, such as cheeks, eyebrows, etc., to calculate the angles x, y, and z, representing the orientation of the user's face. Through these parameters, we determine whether the user has poor posture.

Considering that environments may differ for users, we have designed a feature that allows users to adjust the distance from the screen and the position of their shoulders themselves. This ensures that experiences are better optimized for different settings. Additionally, when the user maintains poor posture for a certain period, a prompt message will be displayed on the GUI interface. Although this paper uses 10 seconds as an example, users can adjust the time as needed.

In Section II we discuss the system's construction, provide an explanation of the system flowchart, and offer detailed insights into the implementation of the four recognition functions. Section III presents the results of these recognition functions, which allow the GUI interface to indicate whether there are any abnormalities in posture based on these findings. Finally, Section IV provides more technical details regarding future work, encountered failures, and challenges during experimentation.

II. SYSTEM IMPLEMENTATION

This section will discuss the overall architecture of the system. First, we will introduce the entire architecture of the system. Next, we present the facial recognition and shoulder recognition functions. Finally, we will explain the relevant settings to run the GUI interface.

A. System Architecture

Fig. 1 depicts the operational flow diagram of our recognition system. At the beginning of the system, OpenCV will activate the camera to capture user images. Users are first required to confirm whether their shoulders are in a proper sitting position via the GUI interface and then adjust the screen-to-face distance accordingly. The collected data and images are then transmitted to MediaPipe for analysis and processing. Once the analysis is complete, the data is sent back to OpenCV for graphical rendering. The processed image, along with user data and all prompt text, is displayed together on the GUI interface, and this process is repeated iteratively.

B. Facial Recognition

The system processes images through MediaPipe, which utilizes its database to recognize faces and transmits the values of facial landmarks to OpenCV for drawing and display. MediaPipe provides 468 facial landmarks for user calculations. We use these landmarks to determine whether the face is misaligned, focusing on four main aspects: Yaw (horizontal tilt), pitch (vertical tilt), roll (rotation), and screen-to-face distance. Based on these data, the system alerts users to any inappropriate posture.

C. Shoulder Recognition

The system analyzes the images using MediaPipe, using its database to recognize the head, hands, limbs, and torso, and marking the corresponding nodes and skeletons. These feature points are then transmitted to OpenCV for drawing and display. We use the feature points at the shoulder joints to identify whether the shoulders are misaligned or if there is poor posture.

D. GUI Interface Operation

Users need to confirm two initial settings. First, they must establish the correct shoulder position, allowing the system to record the data for the correct shoulder position. Verifying the correct shoulder position helps prevent situations where both shoulders are raised simultaneously, but are not recognized as improper posture. Second, users must set the screen-to-face distance. Since the size of the screens varies for each individual, this setting allows the system to record the distance at which the user feels that the screen is too close. When the user's distance from the screen is less than the distance they have set, the system will provide a reminder. This design adds flexibility to the recognition function.

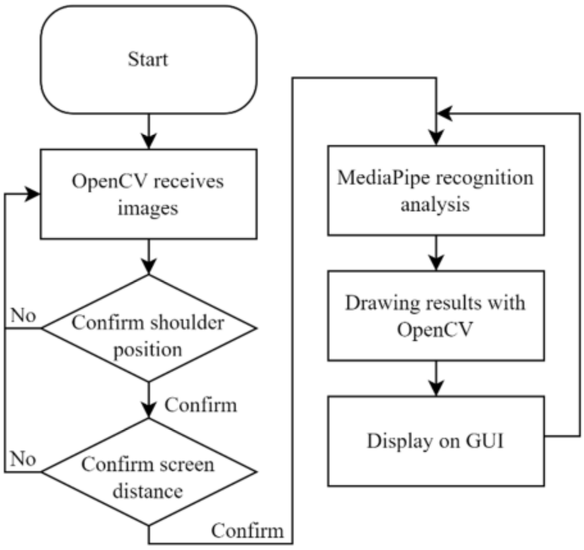

Fig. 1. Recognition system operation flow chart

III. EXPERIMENTS AND RESULTS

The posture correction function in this paper utilizes feature point data computed from MediaPipe's recognition, resulting in four main aspects: recognition of facial yaw and pitch angles, facial roll angle recognition, facial distance from the screen recognition, and shoulder horizontal recognition.

A. Recognition of facial angle of pitch and wrinkle

This recognition function uses the feature points of the eyes, nose, and mouth to calculate the orientation of the face. When the angle of yaw is higher, the absolute value of y increases, as shown in Fig. 2 Similarly, when the pitch angle is higher, the absolute value of x increases, as illustrated in Fig. 3.

B. Recognition of facial roll angle

This recognition function uses the feature points on the left and right cheeks of the face to calculate whether the face has rolled. Calculate the angle by taking the xy values of the feature points on the left and right cheeks. When the rolling angle is greater, the angle itself increases, as shown in Fig. 4.

C. Facial distance from screen recognition

This recognition function utilizes the z-value of the feature point on the nose to calculate the distance of the face from the screen. When the face is closer to the screen, the value becomes smaller, as illustrated in Fig. 5.

D. Horizontal shoulder recognition

This recognition function utilizes the y-value of the feature point on the shoulders to calculate whether the shoulders are tilted horizontally. Calculate the difference in y values between the left and right shoulders as the distance gap. The larger the height difference between shoulders, the greater the value, as shown in Fig. 6.

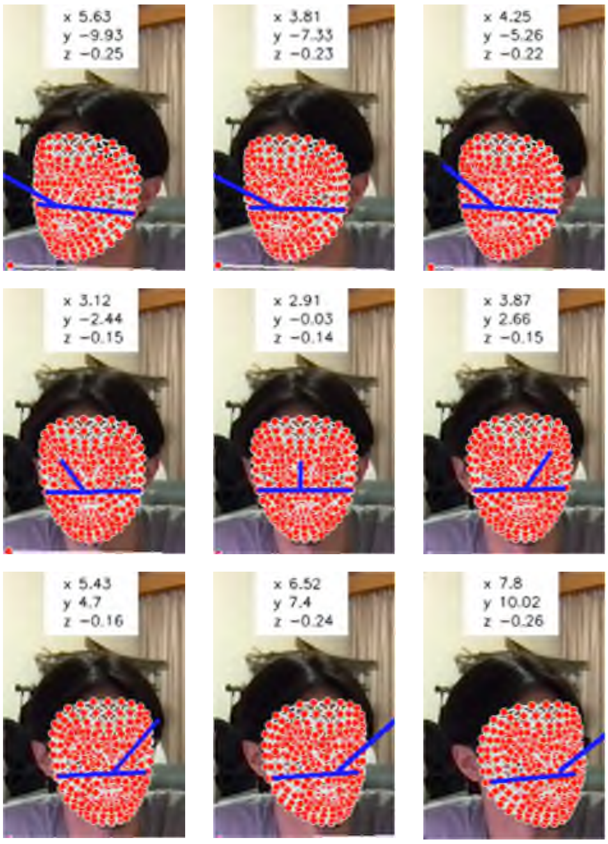

Fig. 2. Recognition of facial yaw angle

 ISBN: 978-1-68558-174-9

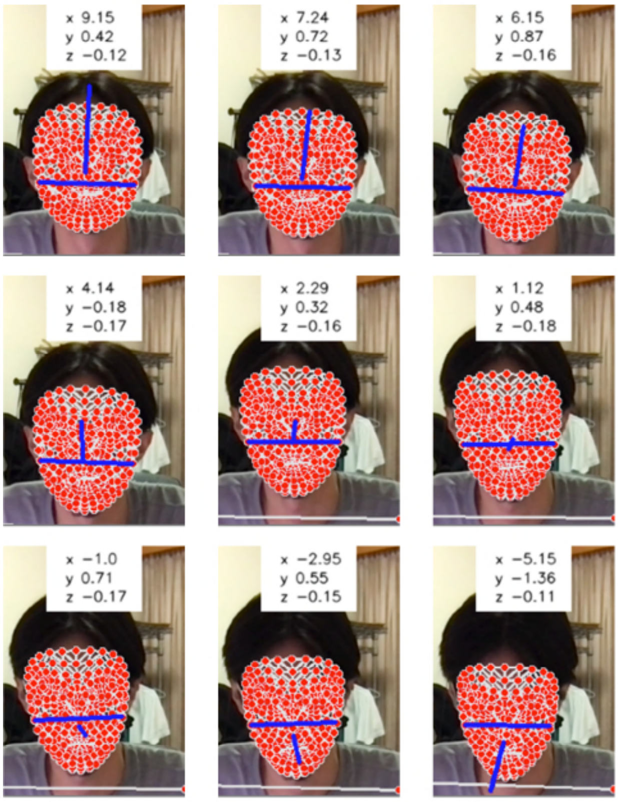

Fig. 3. Recognition of facial pitch angle

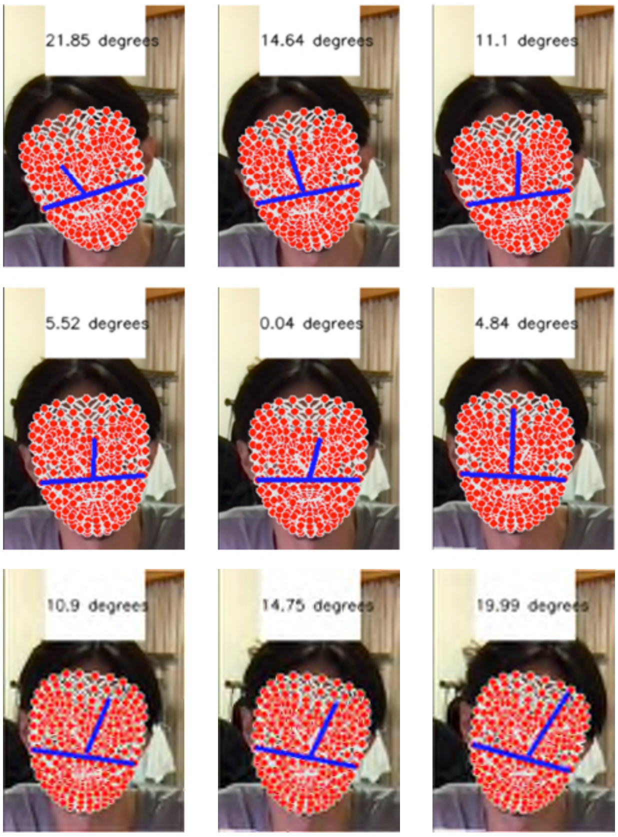

Fig. 4. Recognition of facial row angle

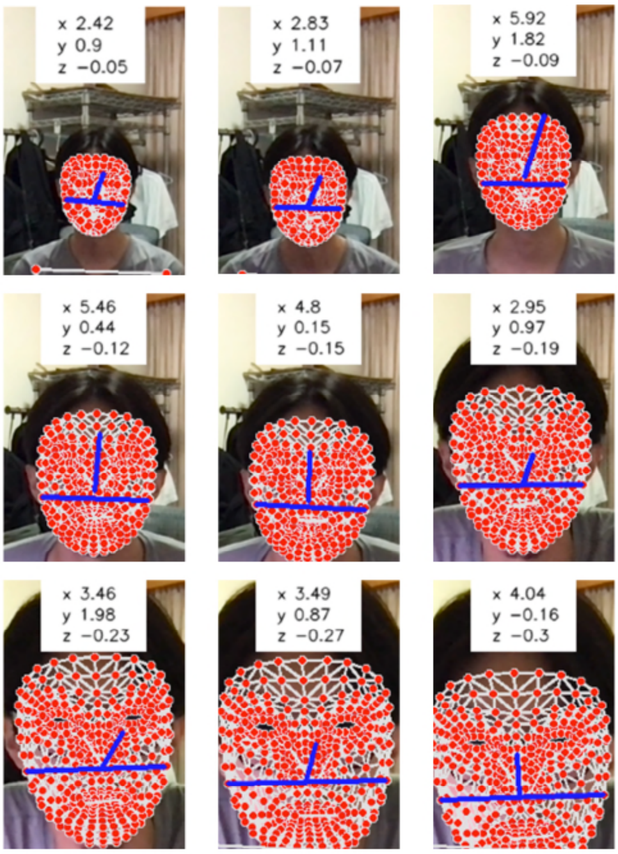

Fig. 5. Screen-to-Face distance recognition

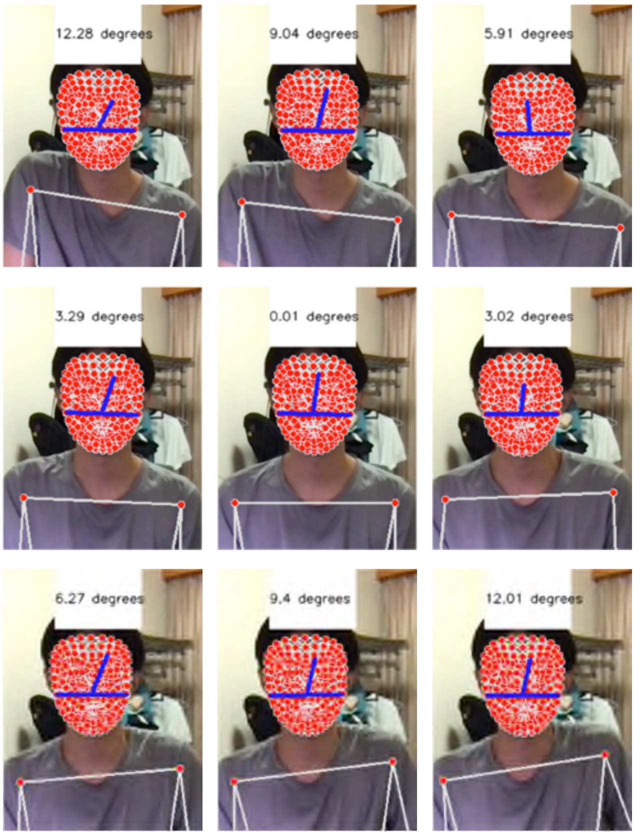

Fig. 6. Horizontal shoulder recognition

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E. *Display of Bad Posture Warning*

When a user continuously maintains bad posture for more than 10 seconds, a warning message will appear on the GUI interface. In addition to displaying the word "WARNING", each of the four recognition functions will also individually display the recognition result on the interface, allowing the user to understand the reasons for poor posture and areas that need adjustment. The result messages are as shown in Table I and the result figures are as shown in Fig. 7, Fig. 8, Fig. 9 and Fig. 10.

TABLE I
RECOGNITION FUNCTION RESULT MESSAGES

	Correct Posture	Incorrect Posture
Facial angle of pitch and wrinkle	good position	bad position
Facial roll angle	normal	askew
Facial distance from screen recognition	normal	too close
Horizontal shoulder	normal	askew

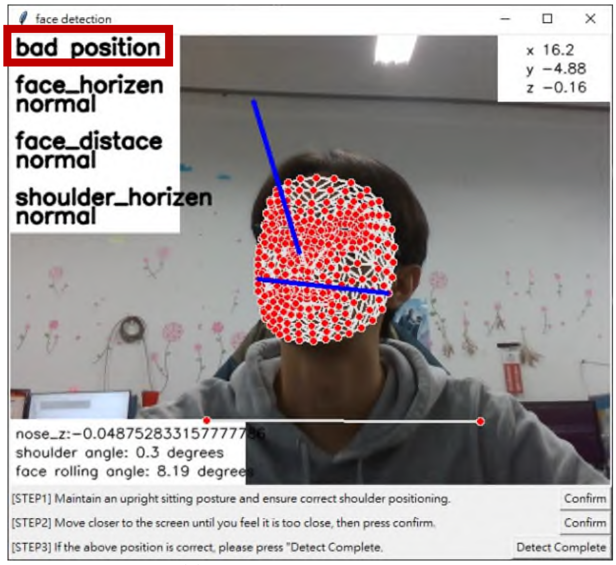

Fig. 7. Results of facial yaw and pitch angle recognition results

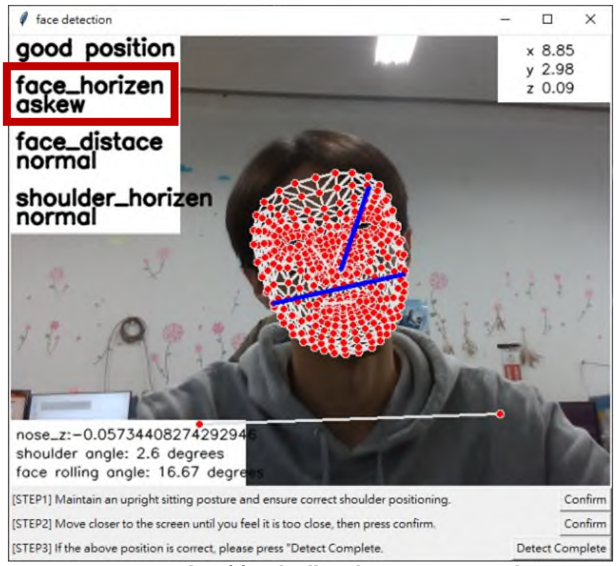

Fig. 8. Results of facial roll angle recognition results

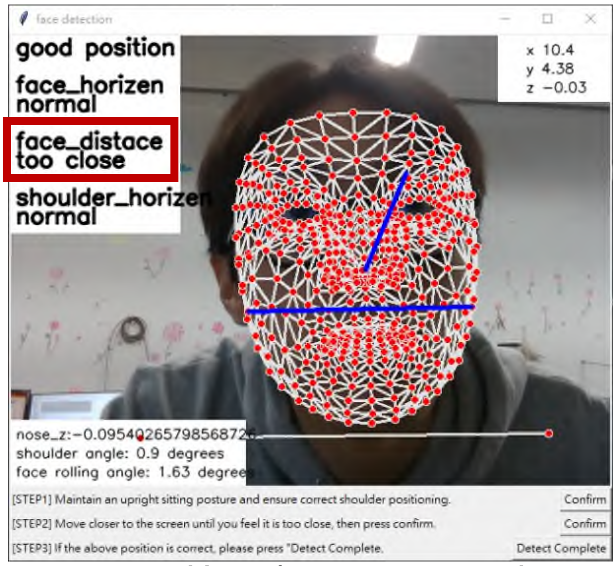

Fig. 9. Facial distance from screen recognition results

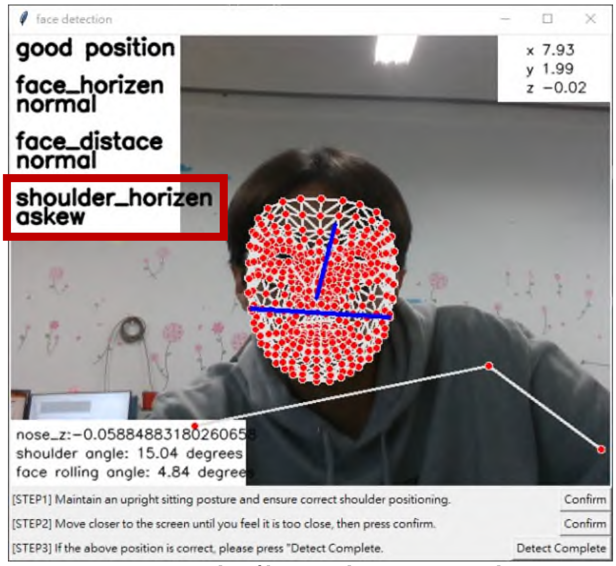

Fig. 10. Results of horizontal recognition results

IV. CONCLUSION AND FUTURE WORK

This paper proposes the use of deep learning, MediaPipe's image recognition framework, and other technologies to remind users to adopt the correct postures when using electronic devices. By leveraging joint points from the MediaPipe framework to design recognition functions, the system can instantaneously recognize sitting postures of users and provide real-time reminders to help them improve poor posture and reduce the risk of eye-related health issues.

The recognition functions and the GUI result display are accurate and smooth, achieving real-time effects. Due to the high accuracy of facial landmarks, the facial recognition function is successful. However, the recognition of shoulder horizontal position sometimes encounters errors and inaccuracies in landmark detection, likely due to the only focus on the upper body. As a result, subtle adjustments in shoulder position may not be properly recognized, leading to occasional failures in shoulder horizontal detection.

In future work, we plan to quantify facial angles and feature point evaluation metrics for comparison with other methods. We also intend to increase the number of subjects to examine whether shoulder level recognition is an individual issue. However, we believe that training a model specifically focused on upper body landmarks can improve the accuracy of shoulder landmark detection, addressing inaccuracies in shoulder horizontal recognition.

ACKNOWLEDGMENTS

This work was supported by National Science and Technology Council of Taiwan under grant NSTC-111-2221-E-027-144.

The authors would like to thank Mr. Hong-Yu Chen and Mr. Bo-Lian Lin from the National Taipei University of Technology for his assistance in the system implementation.

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