CPS 3410 W02: APPLIED ALG. & DATA STRUCTURES

Snake Game Based on Human Hand Recognition

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Introduction

Our group designed a snake game based on human hand recognition. First, we implemented human hand recognition based on the Mediapipe Hands. And we have added the ability to automatically adjust the brightness in the recognition image according to the light in the environment. Finally, we played the Snake game based on the index finger coordinates and set the winning conditions.

Hand recognition under different lights

To detect hands more efficiently, we used cv2 for image processing and display, mediapipe for hand tracking, and set four nodes for each finger. Considering that the image captured by the camera may not be clear under dark light, we set two thresholds: threshold_brightness and threshold_darkness, and use the convertScaleAbs function to perform a brightness scaling operation on the image. When the light is stronger than threshold_brightness, the captured image will automatically reduce the brightness; when the light is weaker than threshold_darkness, the image will enhance the brightness. In addition, we also tested the display of images in an environment with flashing lights.

Play games based on hand recognition

We used the process_frame function to receive image frames as input, and then processed the image including flipping the image, adjusting brightness, detecting hand key points, drawing key points, calculating frame rate and game logic operations, and returning the processed image frame. After that, we use code to open the camera to capture the hand and start looping through each frame.

Inside the loop, the image frame is first processed and then the processed image

frame is displayed. The game captures camera video, detects hand key points, and uses the tip of the person's index finger as control input for the snake. People can control the direction of the snake's movement by sliding their index finger. The goal of the game is to eat as much food as possible, and the snake's body will grow longer as it eats food. After having 15 foods, the game will stop and show victory. We can click the "r" key to restart or the "q" key to exit.

Result

Table 1 The critical distance of camera opponent recognition under different conditions.

Indoors (light)	Indoors (dark)	Indoors (flashing)	Outdoors (dark)	Outdoors (through glass)
2.13m	2.02m	1.98m	1.66m	1.50m
2.22m	1.97m	1.45m	1.99m	1.44m
1.98m	1.80m	1.50m	2.01m	1.00m
1.90m	1.77m	1.69m	1.70m	1.34m
2.15m	1.60m	1.57m	1.85m	1.37m

According to the data, the distance recognized is the furthest indoors with light, and there is not much difference between indoor and outdoor distances in darkness. The indoor distance under flashing lights is slightly smaller than the above two. The detection distance is the shortest when separated by glass.

Conclusion

This project combines hand recognition technology and game design. In this project, we successfully implemented a snake game based on human hand recognition and automatically adjusted image brightness according to light conditions. We also

measured the critical distance of camera opponent recognition under different conditions and got results. Our demo video has been uploaded on YouTube, here is the link. https://youtu.be/Jj3fCVaxksk

References

Zhang, F., Bazarevsky, V., Vakunov, A., Tkachenka, A., Sung, G., Chang, C.-L., & Grundmann, M. (2020). MediaPipe Hands: On-device Real-time Hand Tracking. *ArXiv*.

https://www.semanticscholar.org/paper/84b19524609ad75f309be7f87bcea783e6ecd337