Face recognition and Game

Student: Zulkhairatuly Yerlan

Supervisor: Zhukabayeva T.K.

1. Background

In recent years, human–computer interaction (HCI) has rapidly evolved beyond traditional input methods such as keyboards, mice, and touchscreens. With the rise of advanced computer vision technologies, it is now possible to interact with digital environments using body movements and facial gestures. This development opens the door to more intuitive, immersive, and inclusive ways of interfacing with technology, particularly in fields like gaming, education, and assistive technology.

This project explores the real-time capabilities of face and hand tracking technologies—specifically using OpenCV and MediaPipe—to create a playful and interactive system where users can control games using only their facial expressions, hand gestures, and head movements. The goal is to not only demonstrate the power of these technologies but also to offer a fun, engaging way to test their responsiveness and accuracy.

By combining gesture recognition with classic game mechanics, the project introduces a novel and gamified approach to computer vision testing, making the experience both educational and entertaining. This method allows for direct evaluation of landmark detection reliability in a dynamic environment.

2. Objectives

The main objective of the project is to evaluate the accuracy and responsiveness of real-time face and hand tracking systems using gamification. Rather than testing algorithms in isolation, the system integrates them into classic mini-games that provide immediate feedback and challenge the precision of the technology in real-time scenarios.

Specific objectives include:

1) To implement and test real-time face and hand tracking using MediaPipe's FaceMesh and Hand modules in various environments.
2) To create interactive mini-games that respond solely to user gestures captured via a webcam.
3) To assess the accuracy and usability of the system through practical engagement.
4) To develop a creative and entertaining experience that highlights the potential of gesture-based control systems.
5) To explore the feasibility of controlling multiple game types with different facial and hand inputs, including motion-based navigation and classification.

3. Methods

The system was built entirely in Python and leverages several libraries to enable its core functionality:

1) MediaPipe: For face and hand landmark detection. The FaceMesh module detects over 400 facial landmarks, while the Hand module identifies finger positions and gestures in real time.
2) OpenCV: For webcam capture, image processing, and real-time frame analysis.
3) Pygame: For rendering interactive games and handling game logic.
4) Tkinter: For creating a simple graphical interface to launch games and select images for facial comparison.
5) Multithreading: To ensure smooth performance and responsive gameplay by managing game logic and landmark processing in parallel.

3a. Participants

The facial and hand landmark data are translated into control inputs for each game. For example:

1) In the snake game, the number of raised fingers (0 to 4) controls the movement direction.
2) In flappy bird, a single raised finger triggers a "jump" action.
3) In ping pong, the player controls their paddle using the position of their nose.
4) In the celebrity comparison game, a user's facial landmarks are captured and compared to those of celebrity photos using vector similarity.

Key takeaways:

5) Real-time gesture control is possible and effective even with basic hardware.
6) MediaPipe's FaceMesh and Hand modules are reliable enough for controlling casual games with minimal delay.
7) Gamification significantly increases user engagement and provides a dynamic testing environment.
8) The unique control schemes—such as using the nose to play ping pong or four fingers to control a snake—illustrate the wide-ranging possibilities of gesture-based input systems.

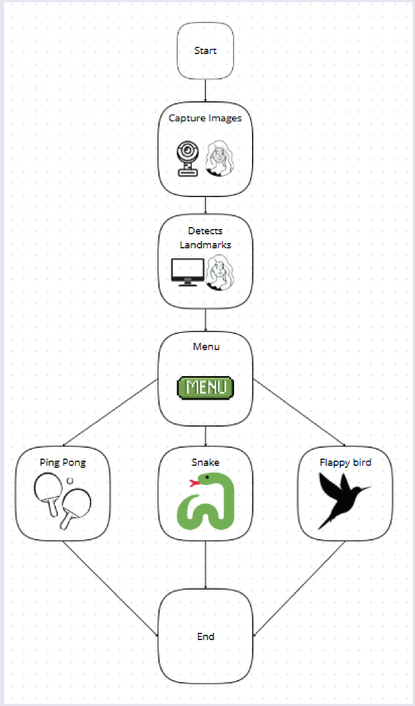
This approach can be expanded for educational tools, assistive devices, or entertainment products, highlighting the future potential of natural user interfaces.

4. Results

The developed system successfully demonstrates that gesture-based control using face and hand tracking is both feasible and engaging. Users can intuitively play four different mini-games using only their body movements, without needing a keyboard or mouse.

1) Face comparison game accurately calculates the similarity between a user's facial landmarks and celebrity images, often producing results within seconds.
2) Snake game responds smoothly to finger gestures, allowing users to direct the snake using only their hand.
3) Flappy bird offers fast, responsive jumping using a single finger gesture.
4) Ping pong creatively transforms the user's nose movement into paddle control, enabling a humorous yet functional gameplay experience.

Performance tests show that the system can operate in real time on modest hardware, with acceptable accuracy for casual interaction. The combination of computer vision and classic game design also proved effective in keeping users engaged during testing.



5. Conclusion

This project successfully demonstrates how advanced facial and hand landmark detection technologies can be creatively applied through gamification. By embedding MediaPipe and OpenCV within mini-games, the system provides an interactive and intuitive way to test gesture recognition accuracy.

References

1. Viola, P., & Jones, M. (2001). Rapid Object Detection using a Boosted Cascade of Simple Features. IEEE Conference on Computer Vision and Pattern Recognition (CVPR).
2. Mediapipe documentation – https://ai.google.dev/edge/mediapipe/solutions/guide?hl=ru
3. OpenCV Library – https://opencv.org/
4. DeepFace Library – https://github.com/serengil/deepface
5. Tkinter Documentation – https://www.riverbankcomputing.com/static/Docs/PyQt5/
6. Pygame documentation – https://www.pygame.org/news

Github link:

Contact details

Zulkhairatuly Yerlan
050524551510@enu.kz