

CSE 5524 Project Report

Group 11

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Project Title:

Rock Paper Scissors

Project Description:

Our project aims to detect who is the winner (2 players) of the game rock-paper-scissor. The game will be held in 5 rounds, the winner will be the person who wins 3 times. Game rules: rock > scissor; rock < paper; paper < scissor.

Group Work Allocation:

Zack Wang: Isolate Gesture

Jiaxuan Niu: Extract Gesture

Yu Huo: Identify Gesture & Decide Game Result

Data Collection:

Our data is in picture form. We photo them in baker system classroom in front of a blackboard. They consist of few parts. Blackboard is background. And there are arms and hands of two players who played the game with their gestures of rock paper or scissors in front of the blackboard.

Step One Isolate Gesture:

What we try to achieve at the first step is to isolate two players' gestures and find two gestures from images. The method we use for this part is region extractions. To achieve region extraction. We prepared background images as well. The first thing to do is to extract the foreground regions. Pictures are subtracted from the background image so that there will be only arms and hands area after isolating. It is shown as white color in the isolation photo. We prepare two background images and average them to get a smoother background to eliminate potential unwanted background stain. What we do next is to set thresholds to choose a better isolation

output. Most of the data will have a good output with threshold set to 100. However, when the palm faces you, threshold set to 100 will leave a black area inside the palm. This will be tricky to future identification. So, we changed the threshold to 50 to make the whole hands part white.

We tried K-means as the tool to isolate gestures at first. The more clusters we set, the more layers there will be. Since upper bright parts are more like the color of hands instead of dark background. We cannot fix the upper large white areas. That is the reason why we switch our tool to region extraction.

Step Two Extract Gesture:

Our goal is to identify and extract hand gestures from a given image. Initially, we attempted to use the DFS algorithm, but we encountered difficulties and were unable to make progress.

Therefore, we switched to the NCC algorithm. To speed up processing time, we downsampled the original image by a factor of ten. Using the NCC algorithm, we identified the best-matching hand gesture in the image. However, this only extracted hand gestures from the left side of the image. Since the search image contains hand gestures on both sides and the template image only contains a hand gesture from the left side, we rotated the image to extract the sub-image from the right side as well.

In addition, we have identified an area for future improvement. We discovered that regardless of which template image we choose, we are able to extract the hand gesture successfully. For instance, selecting a rock template can even extract a paper hand gesture because the paper gesture best matches the rock template, compared with other stuff in the search image. As such, we need to further refine our approach to ensure that the extracted hand gestures are accurate and reliable.

Step Three Identify Gesture:

At first, the input for identifying the gesture part is a sub-image that contains one hand from the original image. In this part, we implemented the Normalized Cross-Correlation algorithm.

Different from extracted gesture part, we aimed to compute the NCC value for different templates (rock, paper, and scissors). After calling the NCC function three times, we can get three values for an image of a hand. Then, we need to find the maximum value in these three NCC values. The corresponding gesture for the highest NCC value is what we found for the input. In

order to make it easier, we used integers as the symbol for each gesture. Rock is 1; Paper is 2; Scissors is 3. Finally, the outputs of this part are five arrays, each containing the two gestures' integer, the first element represents the gesture of the left person, whereas the second element represents the gesture of the right person.

Step Four Decide Game Result:

In the last part, we aimed to find out who is the winner for each round of the game and who is the final winner. In order to achieve this goal, we created a function that implemented the rule of the game: rock wins scissors, paper wins rock, and scissors wins paper. In addition to determining who is the winner, this function can also count the number of wins for each person. If the left person wins, increase the variable used to count the number of wins for the left person by 1 and circle the gesture. If the right person wins, do the same action. After determining 5 rounds of the game, we need to find whose number of wins exceeds or is equal to three. If the left person wins no less than 3 times, then output "the left person is the winner". If the right person wins no less than 3 times, output "the right person is the winner". If no one wins 3 times or more, which means there are one or more draws, then output "no winner in 5 rounds".

Improvement:

There are some improvements that we want to do in the future. The first one is the method of gesture extraction is not very professional. We used to try the depth-first-search algorithm, but its workload is extremely large for one image. We would like to find a more efficient and professional way to improve the extraction part in the future. The second limitation is that our project can only deal with slight illumination changes. If the difference in illumination of two different images is large, our project may not identify the extracted gesture correctly, so in the extraction region part, we would like to do more steps to unify the illumination. The third one is that we didn't consider the draw which means two people show the same gesture in one round. We would like to ask the client to take one more round if the current round is a draw.

Conclusion:

The purpose of this project is to help us to practice the knowledge learned from class in a real-world problem. In this project, we implemented region extraction, image segmentation, and

template matching. Finally, we can successfully determine who is the winner of the scissor-paper-rock game in 5 rounds. In future improvements, we could like to make the project more professional and efficient.