Gesture Recognizer

In this experiment, we used two algorithms to attempt at recognizing gestures through machine learning. First, we implemented a shape matching algorithm by simply aligning all of our results on the x, y, and z dimensions. We took the maximum value and aligning all the values on this point for each trial, and took the average of gesture to create an average shape for our algorithm. Finally, we find the Euclidian difference of the unknown gesture to our averaged shapes. The smallest total difference is the gesture we return. Using this, for Jon’s data, I got the following data:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Jon’s Dataset | | | My Dataset | | |
|  | Gesture | Pass | Total | % | Pass | Total | % |
| 1 | At Rest | 5 | 5 | 100% | 5 | 5 | 100% |
| 2 | Backhand Tennis | 5 | 5 | 100% | 4 | 5 | 80% |
| 3 | Baseball Throw | 5 | 5 | 100% | 5 | 5 | 100% |
| 4 | Forehand Tennis | 5 | 5 | 100% | 5 | 5 | 100% |
| 5 | Midair Clockwise O | 5 | 5 | 100% | 4 | 5 | 80% |
| 6 | Midair Counter Clockwise O | 5 | 5 | 100% | 5 | 5 | 100% |
| 7 | Midair S | 5 | 5 | 100% | 5 | 5 | 100% |
| 8 | Midair Zorro Z | 5 | 5 | 100% | 5 | 5 | 100% |
| 9 | Shake | 4 | 5 | 80% | 5 | 5 | 100% |
| 10 | Underhand Bowling | 3 | 5 | 60% | 5 | 5 | 100% |
| 11 | Custom Gesture | 0 | 0 | - | 5 | 0 | - |
|  | Total | 47 | 50 | 94% | 53 | 55 | 96.36% |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Jon’s Dataset | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | 5 |  |  |  |  |  |  |  |  |  |
| 2 |  | 5 |  |  |  |  |  |  |  |  |
| 3 |  |  | 5 |  |  |  |  |  |  |  |
| 4 |  |  |  | 5 |  |  |  |  |  |  |
| 5 |  |  |  |  | 5 |  |  |  |  |  |
| 6 |  |  |  |  |  | 5 |  |  |  |  |
| 7 |  |  |  |  |  |  | 5 |  |  |  |
| 8 |  |  |  |  |  |  |  | 5 |  |  |
| 9 |  | 1 |  |  |  |  |  |  | 4 |  |
| 10 |  |  |  | 2 |  |  |  |  |  | 3 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| My Dataset | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | 5 |  |  |  |  |  |  |  |  |  |  |
| 2 |  | 4 |  |  |  |  |  |  |  |  | 1 |
| 3 |  |  | 5 |  |  |  |  |  |  |  |  |
| 4 |  |  |  | 5 |  |  |  |  |  |  |  |
| 5 | 1 |  |  |  | 4 |  |  |  |  |  |  |
| 6 |  |  |  |  |  | 5 |  |  |  |  |  |
| 7 |  |  |  |  |  |  | 5 |  |  |  |  |
| 8 |  |  |  |  |  |  |  | 5 |  |  |  |
| 9 |  |  |  |  |  |  |  |  | 5 |  |  |
| 10 |  |  |  |  |  |  |  |  |  | 5 |  |
| 11 |  |  |  |  |  |  |  |  |  |  | 5 |

As for my Model based classification approach, I trained on only a few features, specifically the maximum X, Y, Z, and magnitude of the gestures. These were trained on a SVM classifier. I got the following data:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Jon’s Dataset | | | My Dataset | | |
|  | Gesture | Pass | Total | % | Pass | Total | % |
| 1 | At Rest | 5 | 5 | 100% | 5 | 5 | 100% |
| 2 | Backhand Tennis | 5 | 5 | 100% | 4 | 5 | 80% |
| 3 | Baseball Throw | 5 | 5 | 100% | 5 | 5 | 100% |
| 4 | Forehand Tennis | 5 | 5 | 100% | 5 | 5 | 100% |
| 5 | Midair Clockwise O | 5 | 5 | 100% | 4 | 5 | 80% |
| 6 | Midair Counter Clockwise O | 0 | 5 | 100% | 5 | 5 | 100% |
| 7 | Midair S | 5 | 5 | 100% | 5 | 5 | 100% |
| 8 | Midair Zorro Z | 5 | 5 | 100% | 5 | 5 | 100% |
| 9 | Shake | 2 | 5 | 80% | 5 | 5 | 100% |
| 10 | Underhand Bowling | 5 | 5 | 60% | 5 | 5 | 100% |
| 11 | Custom Gesture | 0 | 0 | - | 5 | 0 | - |
|  | Total | 42 | 50 | 84% | 53 | 55 | 96.36% |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Jon’s Dataset | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1 | 5 |  |  |  |  |  |  |  |  |  |
| 2 |  | 5 |  |  |  |  |  |  |  |  |
| 3 |  |  | 5 |  |  |  |  |  |  |  |
| 4 |  |  |  | 5 |  |  |  |  |  |  |
| 5 |  |  |  |  | 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  | 5 |  |  |  |
| 8 |  |  |  |  |  |  |  | 5 |  |  |
| 9 |  |  |  |  |  |  |  |  | 2 | 3 |
| 10 |  |  |  |  |  |  |  |  |  | 5 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| My Dataset | | | | | | | | | | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1 | 5 |  |  |  |  |  |  |  |  |  |  |
| 2 |  | 5 |  |  |  |  |  |  |  |  |  |
| 3 |  |  | 5 |  |  |  |  |  |  |  |  |
| 4 |  |  |  | 5 |  |  |  |  |  |  |  |
| 5 | 2 |  |  |  | 3 |  |  |  |  |  |  |
| 6 |  |  |  |  | 2 |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  | 5 |  |  |  |  |
| 8 |  |  |  |  |  |  |  | 5 |  |  |  |
| 9 |  |  |  |  |  |  |  |  | 5 |  |  |
| 10 |  |  |  |  |  |  |  |  |  | 5 |  |
| 11 |  |  | 1 |  | 2 |  |  |  |  |  | 2 |

A strange occurrence happened with Gesture 6: Midair Counter Clockwise O. For many of these tests, some predictions don’t even occur, while they do still occur for others, albeit incorrectly.

The biggest challenges during this assignment was executing the algorithm correctly. There were many intricacies across functions and this made debugging a real issue. Moreover, we had to learn how to import multiple features across files into our classifier and such technical issues were challenging.

I learned how different machine learning algorithms perform and that with a small dataset, a reliable algorithm is incredibly hard to achieve. The route with a classifier, while easier, for smaller datasets like this a more comprehensive algorithm would be preferred.