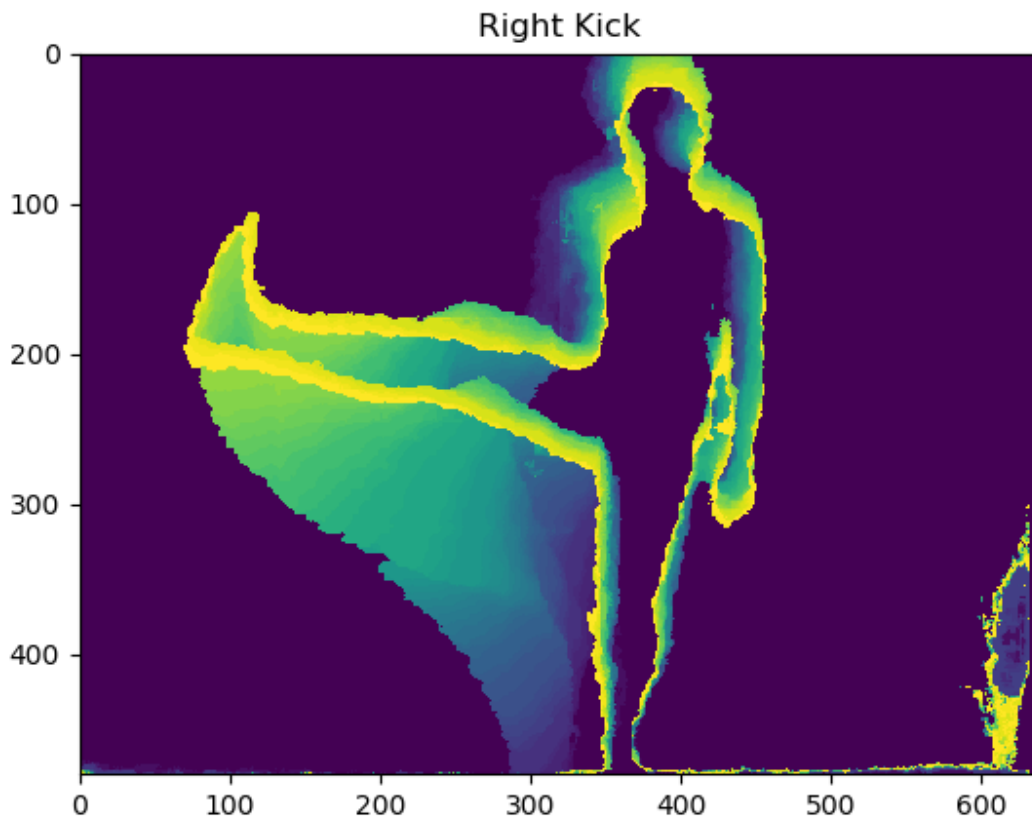
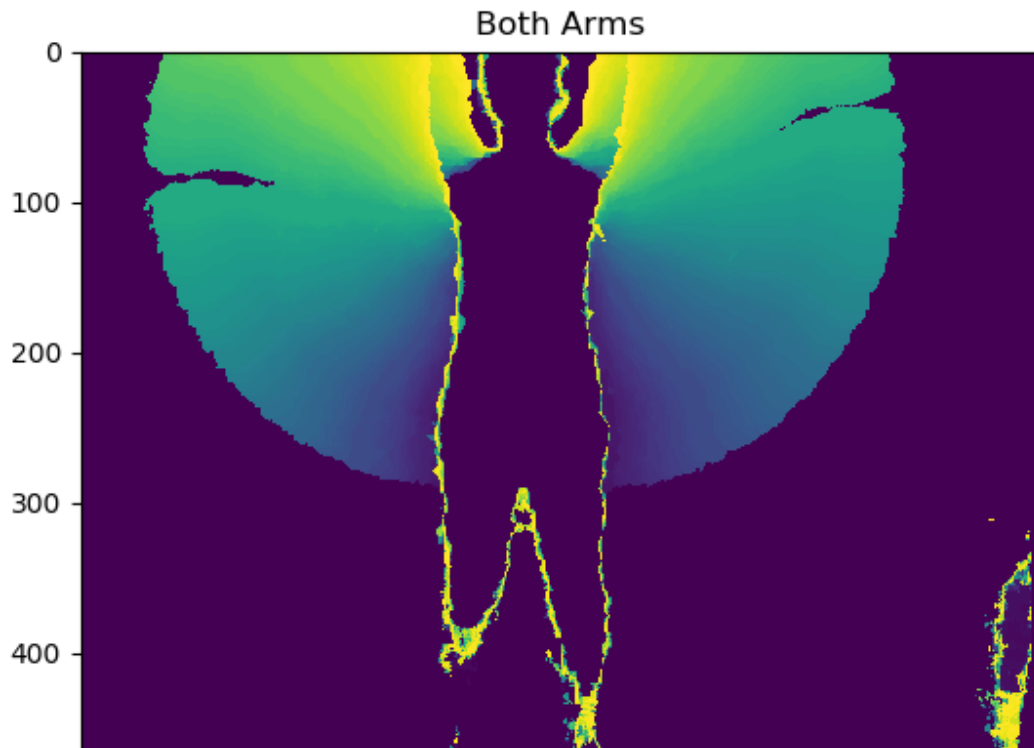
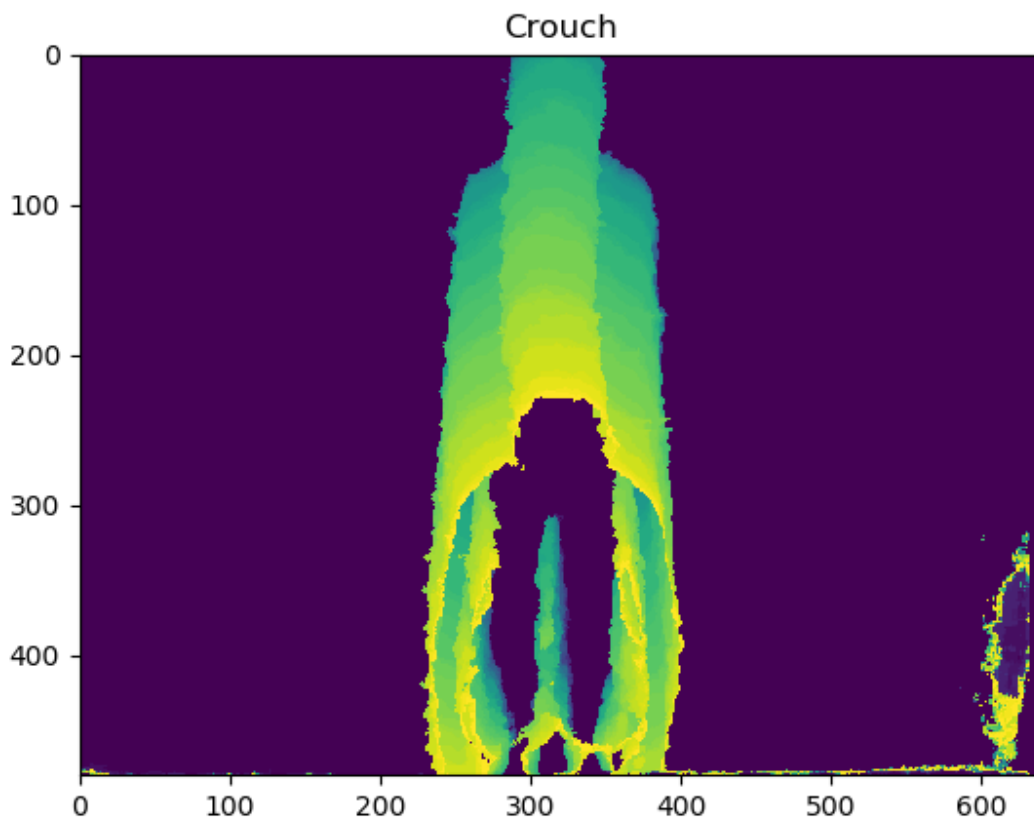


1. computeMHI

The following three images are the Motion History Images of botharms-up-p1-1, crouch-p1-1, and rightkick-p1-1.

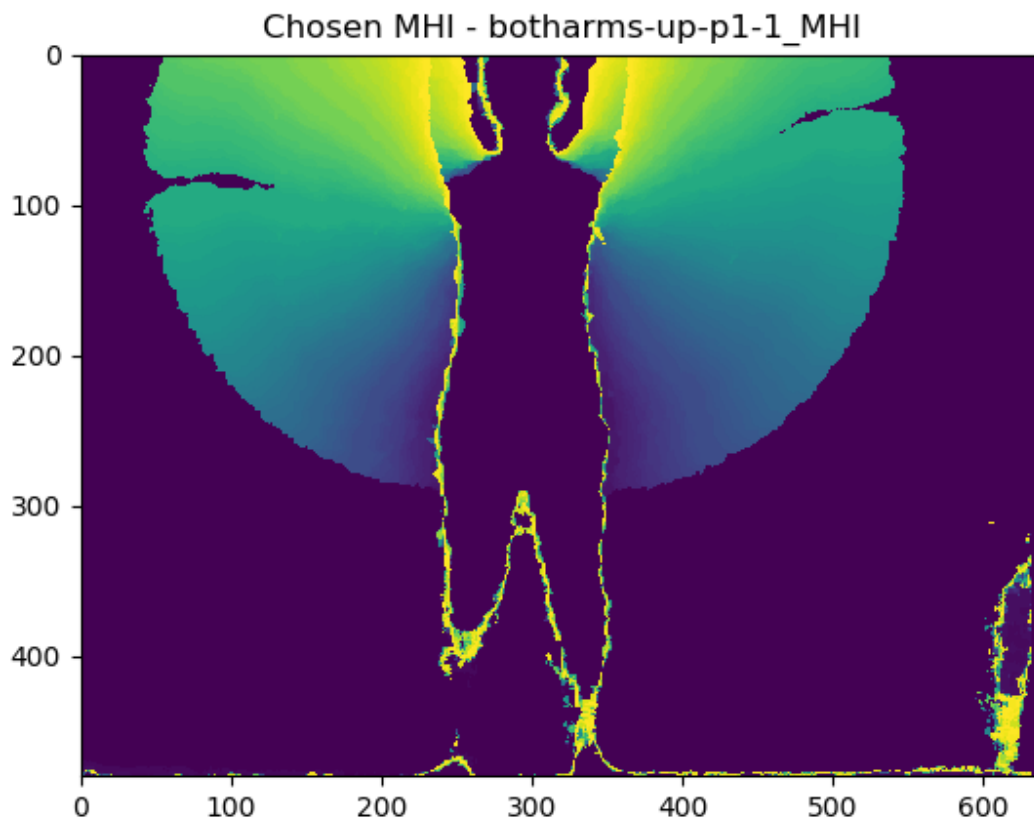




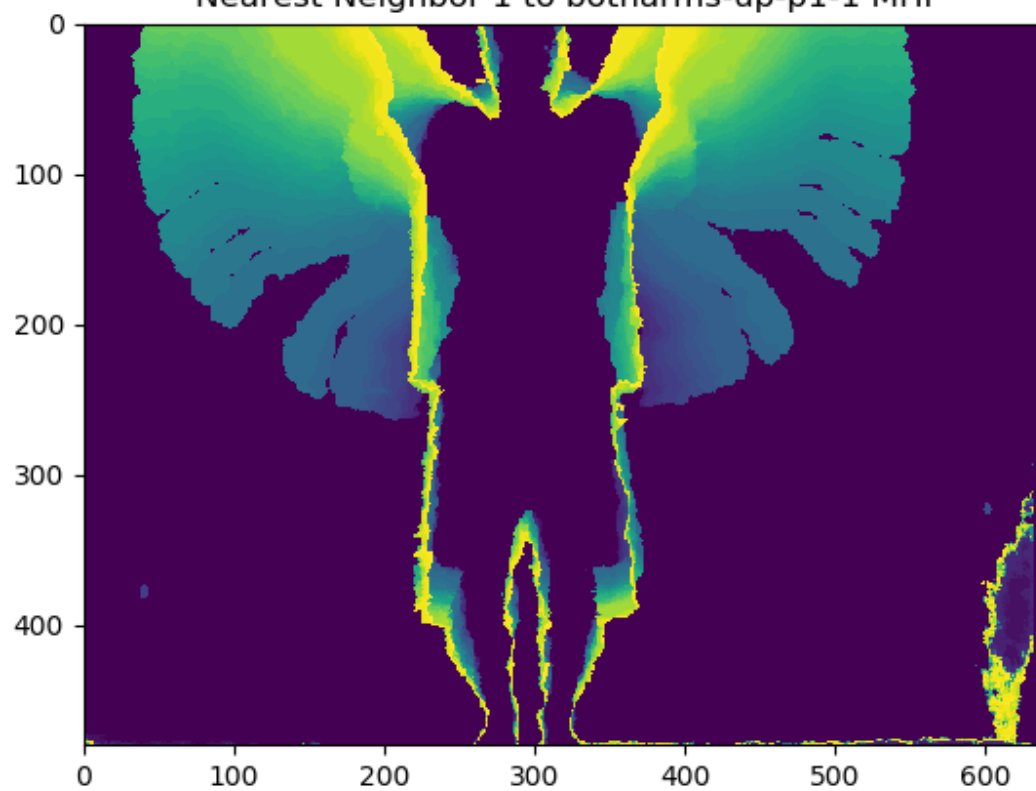
2. The Hu moments vector is stored in huVectors.npy.

3. Using both arms, right kick, and crouch Hu moments vectors stored from the script created for (2), we received 1, 5, and 2, the correct corresponding action values.

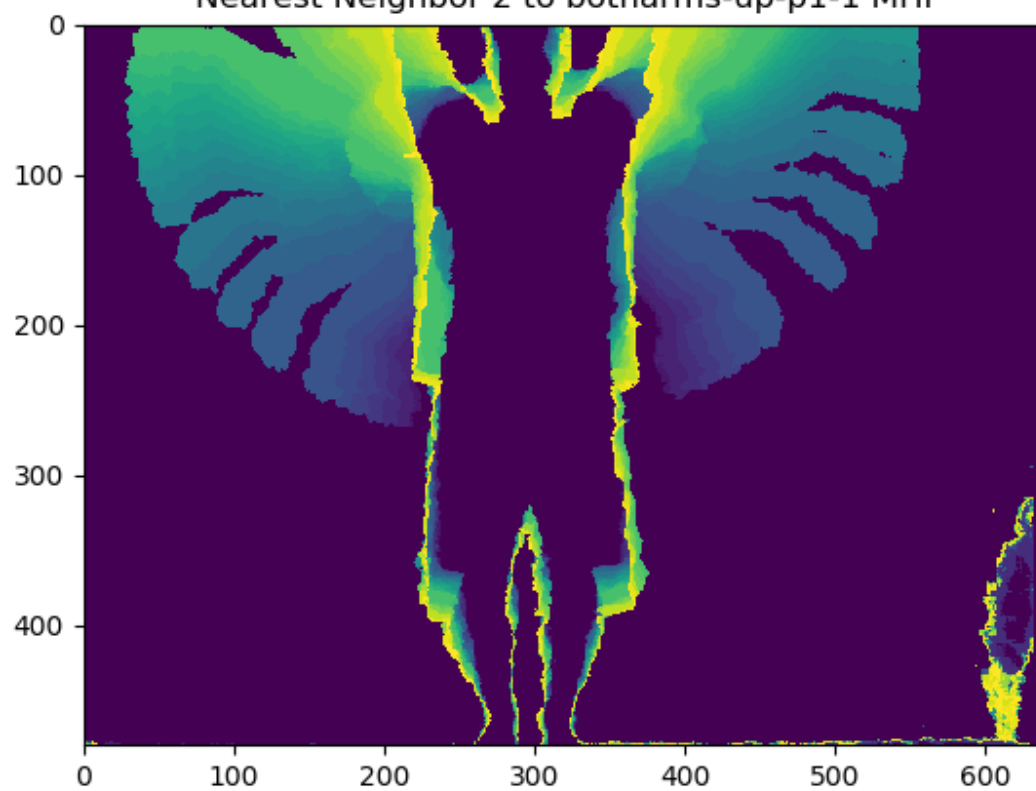
4. The following two groups of five figures include a chosen MHI and its four nearest neighbors. The first chosen image botharms-up-p1-1 while the second is rightkick-p1-1. The distance method used is normalized Euclidean distance.



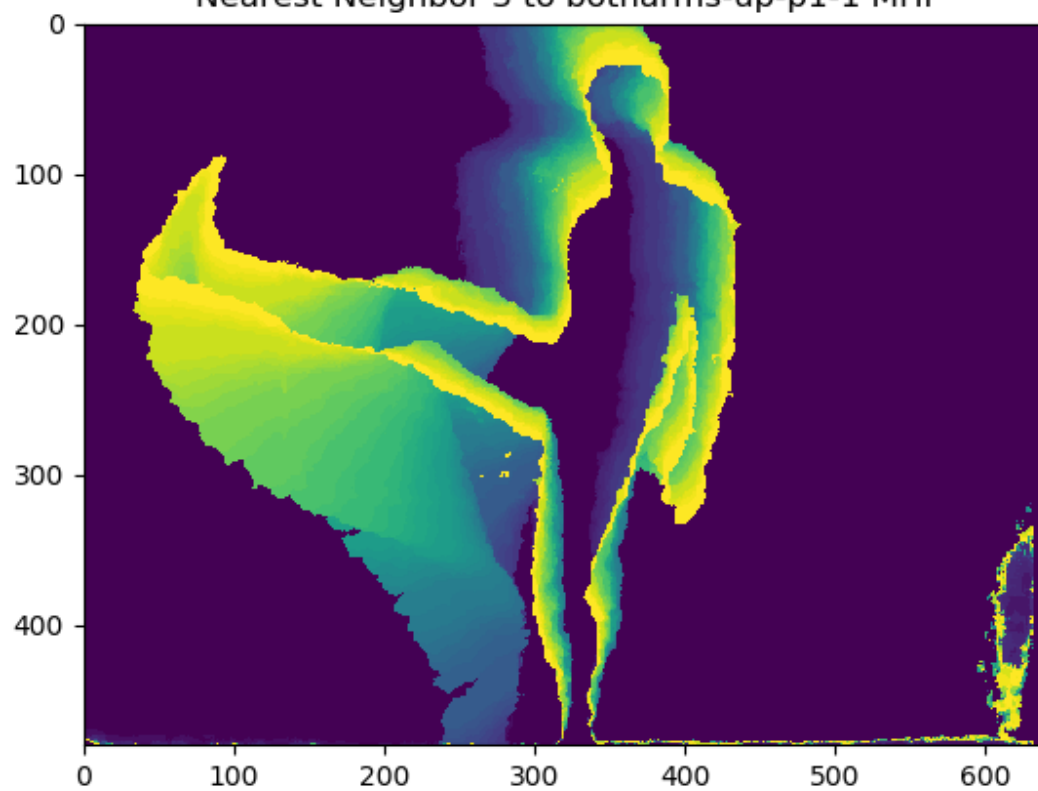
Nearest Neighbor 1 to botharms-up-p1-1 MHI



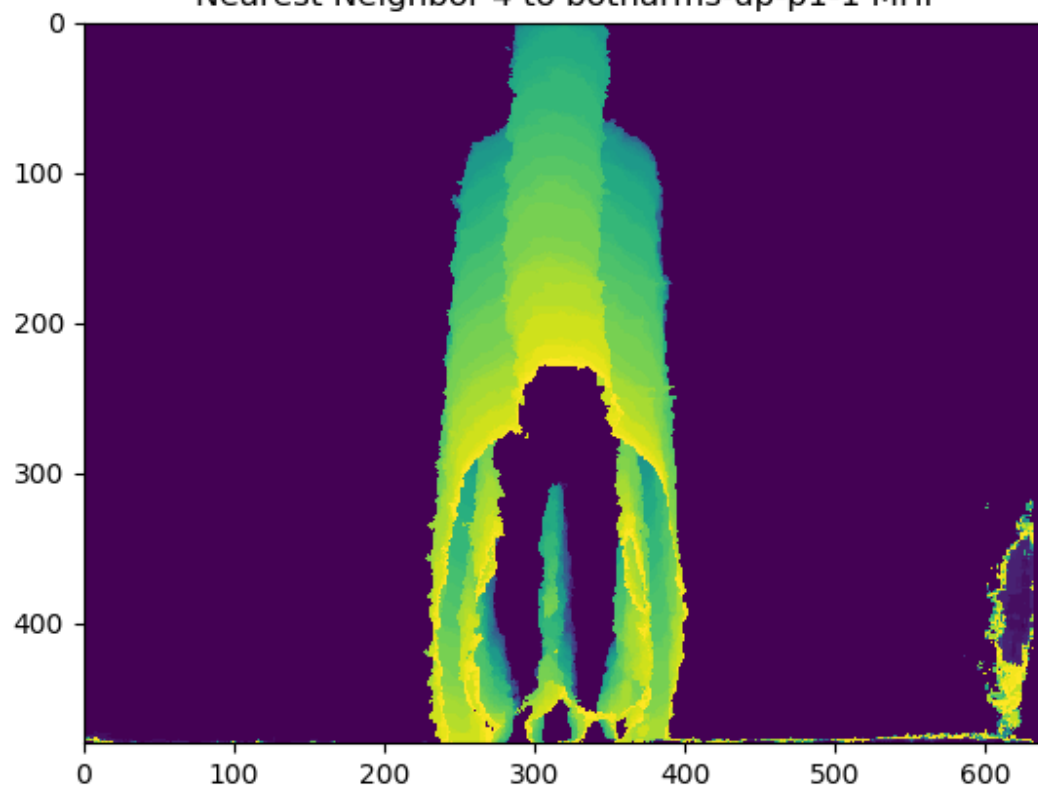
Nearest Neighbor 2 to botharms-up-p1-1 MHI



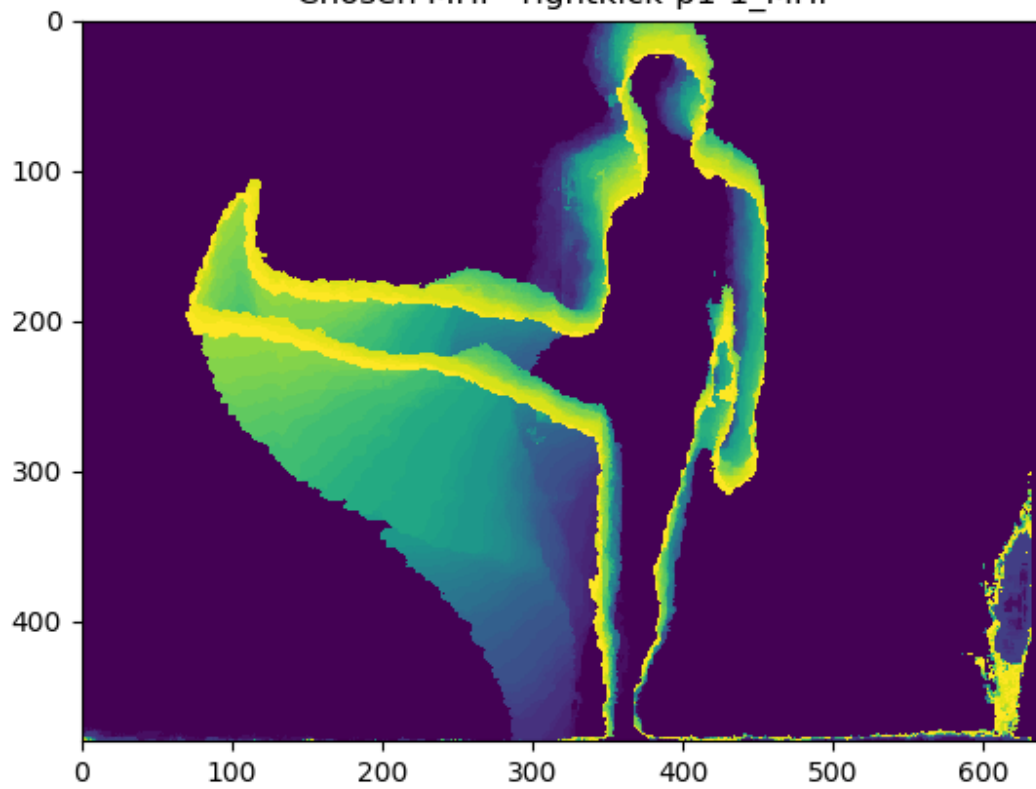
Nearest Neighbor 3 to botharms-up-p1-1 MHI



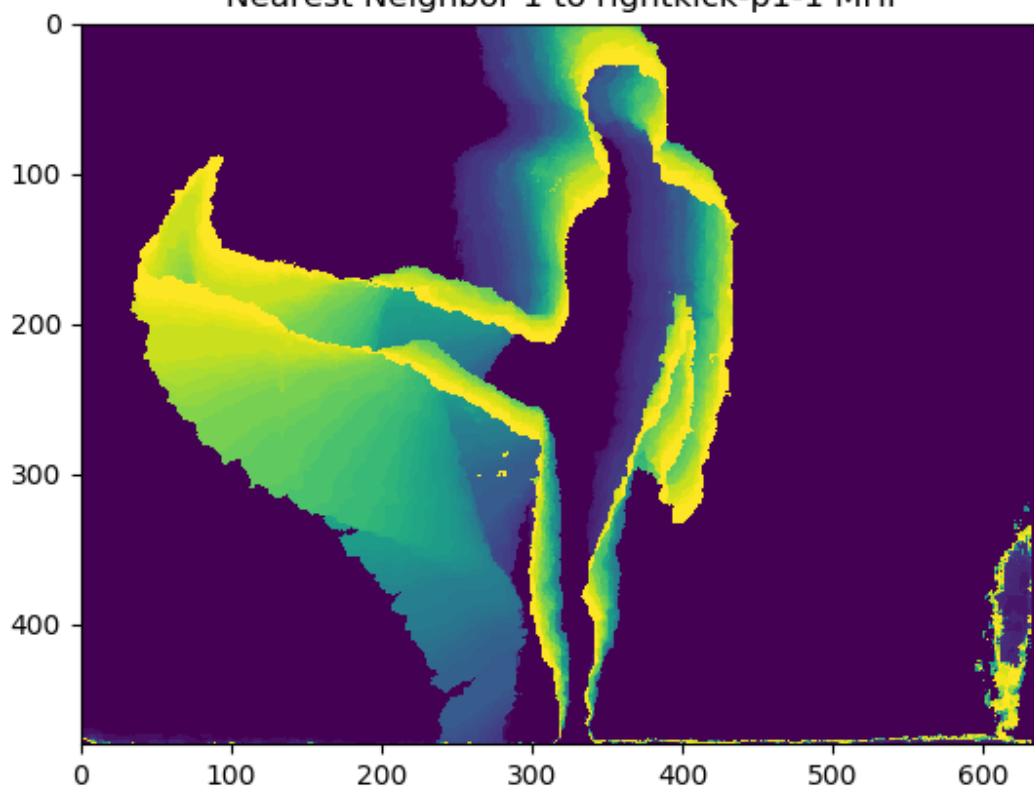
Nearest Neighbor 4 to botharms-up-p1-1 MHI

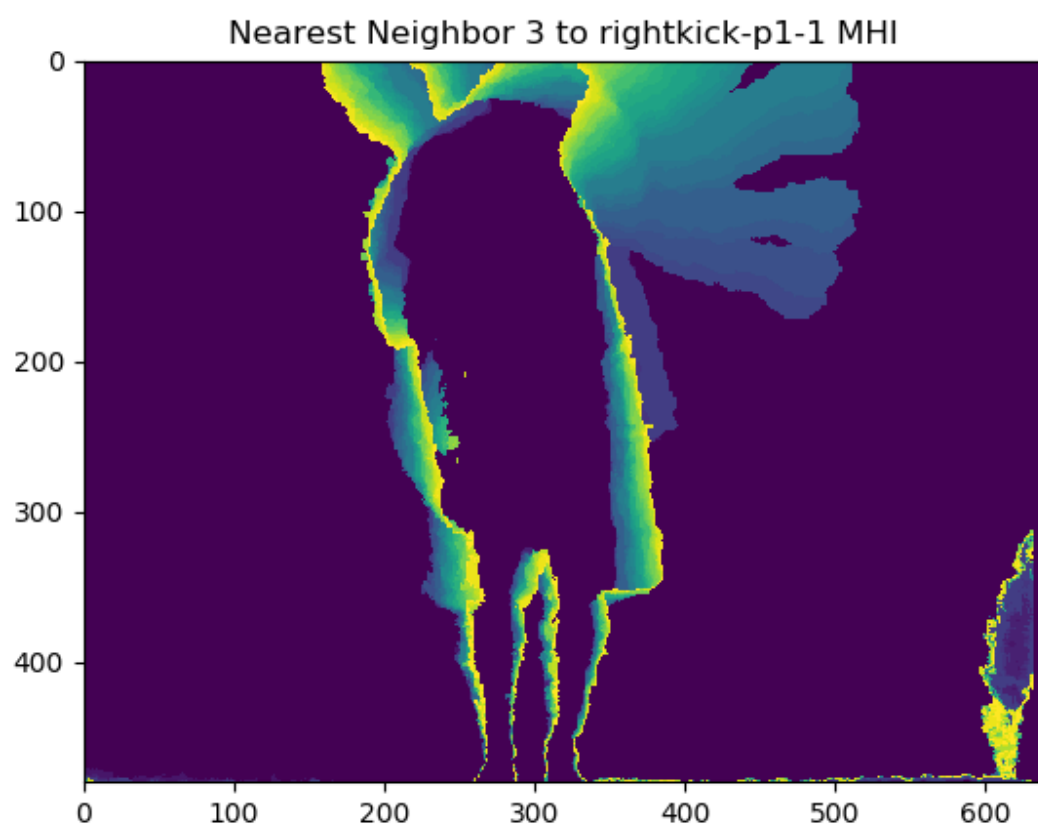
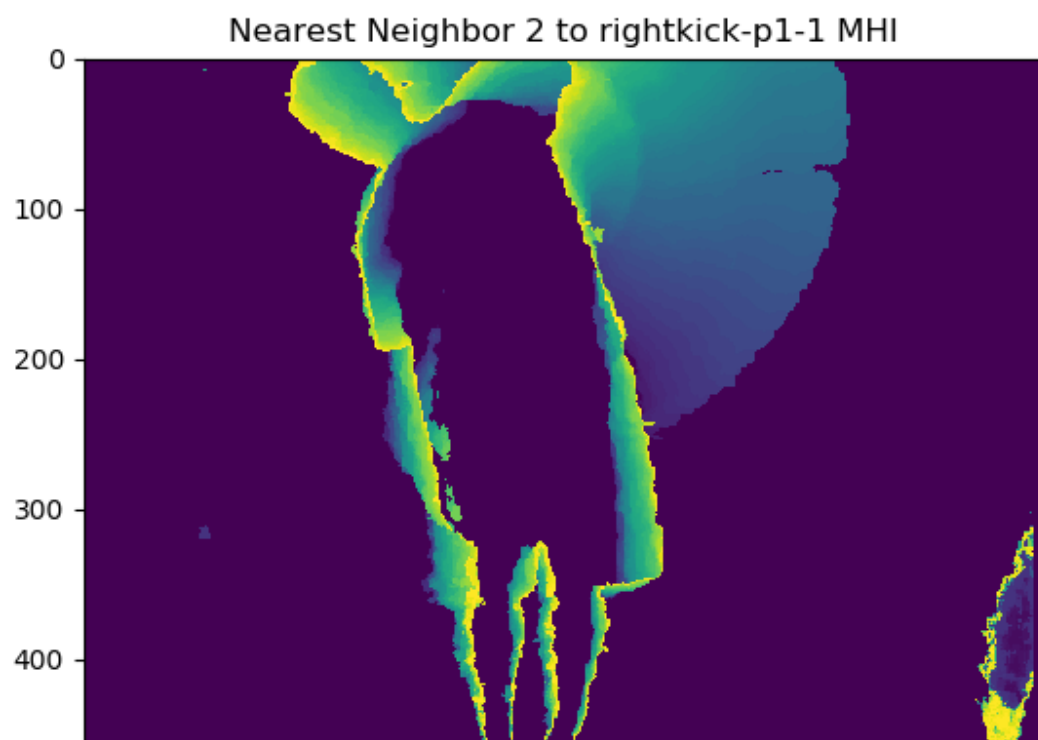


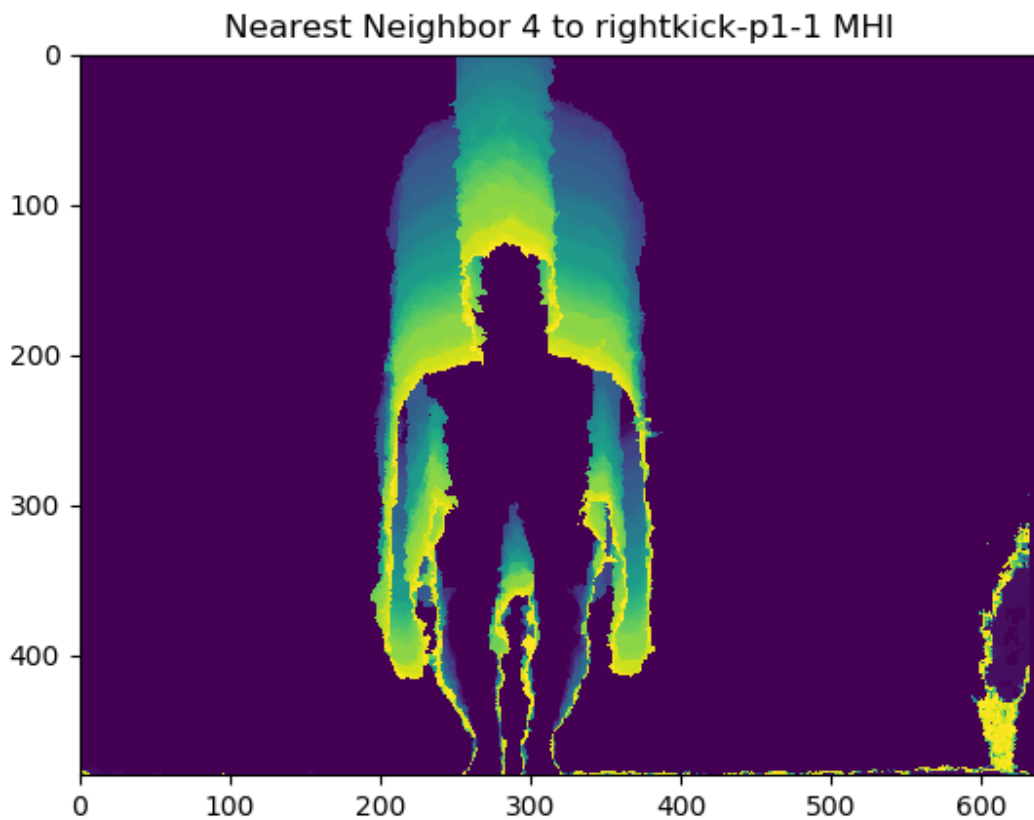
Chosen MHI - rightkick-p1-1\_MHI



Nearest Neighbor 1 to rightkick-p1-1 MHI







5. The following tables show the mean recognition rate per class and a confusion matrix. Both arms up and left arm up both demonstrated a recognition rate of 1 while crouch and right kick have recognition rates of 0.5. Punch is in the middle with a recognition rate of 0.75. Left arm up was the most confused class for the other classes. This is likely a result of an arch in left arm up that was also present in the failed MHIs. Normalized Euclidean distance was somewhat effective for labeling the MHI.

| Recognition Rate |      |
|------------------|------|
| Both arms up     | 1    |
| Crouch           | 0.5  |
| Left arm up      | 1    |
| Punch            | 0.75 |
| Right kick       | 0.5  |

|              | Both arms up | Crouch | Left arm up | Punch | Right kick |
|--------------|--------------|--------|-------------|-------|------------|
| Both arms up | 4            | 0      | 0           | 0     | 0          |
| Crouch       | 0            | 2      | 1           | 1     | 0          |
| Left arm up  | 0            | 0      | 4           | 0     | 0          |
| Punch        | 0            | 0      | 1           | 3     | 0          |
| Right kick   | 0            | 0      | 2           | 0     | 2          |

Extra credit:

Using Minkowski distance of order 3 resulted in a significantly worse performance for all the classes except for right kick. Right kick saw a recognition rate of 1 while left arm up become a significant class in the confusion matrix:

| Recognition Rate |      |
|------------------|------|
| Both arms up     | 0    |
| Crouch           | 0    |
| Left arm up      | 0.75 |
| Punch            | 0    |
| Right kick       | 1    |

|              | Both arms up | Crouch | Left arm up | Punch | Right kick |
|--------------|--------------|--------|-------------|-------|------------|
| Both arms up | 0            | 0      | 1           | 0     | 3          |
| Crouch       | 0            | 0      | 2           | 0     | 2          |
| Left arm up  | 0            | 0      | 3           | 0     | 1          |
| Punch        | 0            | 0      | 3           | 0     | 1          |
| Right kick   | 0            | 0      | 0           | 0     | 4          |

Using Manhattan distance resulted in worse performance with none of the classes gaining in recognition while left arm up was the most confused class:

| Recognition Rate |     |
|------------------|-----|
| Both arms up     | 0   |
| Crouch           | 0   |
| Left arm up      | 0.5 |
| Punch            | 0   |
| Right kick       | 0   |



|              | Both arms up | Crouch | Left arm up | Punch | Right kick |
|--------------|--------------|--------|-------------|-------|------------|
| Both arms up | 0            | 0      | 4           | 0     | 3          |
| Crouch       | 0            | 0      | 4           | 0     | 2          |
| Left arm up  | 0            | 0      | 2           | 0     | 2          |
| Punch        | 0            | 0      | 4           | 0     | 1          |
| Right kick   | 0            | 0      | 4           | 0     | 4          |

Using a normalized Minkowski distance gives better results for both arms up and punch although there is more confusion across several classes:

| Recognition Rate |      |
|------------------|------|
| Both arms up     | 0.5  |
| Crouch           | 0    |
| Left arm up      | 0.5  |
| Punch            | 0.25 |
| Right kick       | 0    |

|              | Both arms up | Crouch | Left arm up | Punch | Right kick |
|--------------|--------------|--------|-------------|-------|------------|
| Both arms up | 2            | 0      | 0           | 0     | 2          |
| Crouch       | 0            | 0      | 1           | 2     | 1          |
| Left arm up  | 0            | 1      | 2           | 1     | 2          |
| Punch        | 0            | 1      | 1           | 1     | 1          |
| Right kick   | 3            | 1      | 0           | 0     | 0          |

Finally, non-normalized Euclidean distance results in slightly worse performance than normalized Euclidean as seen below:

| Recognition Rate |      |
|------------------|------|
| Both arms up     | 1    |
| Crouch           | 0.25 |
| Left arm up      | 0.5  |
| Punch            | 0.25 |
| Right kick       | 0.5  |

|              | Both arms up | Crouch | Left arm up | Punch | Right kick |
|--------------|--------------|--------|-------------|-------|------------|
| Both arms up | 4            | 0      | 0           | 0     | 0          |
| Crouch       | 0            | 1      | 2           | 1     | 0          |
| Left arm up  | 0            | 2      | 2           | 0     | 0          |
| Punch        | 0            | 3      | 0           | 1     | 0          |
| Right kick   | 0            | 2      | 0           | 0     | 2          |

As demonstrated by the use of several distance functions, the normalized Euclidean distance gave the best recognition rate with the least confusion.