**PART1**

(a)

FP1: left loop

FP2: right loop

FP3: right loop

FP4: whorl

FP5: left loop

FP6: left loop

FP7: whorl

Part 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FP** | **FP** | **Delta x** | **Delta y** | **Delta theta** |
| FP1 | FP2 | -21.4246652087669 | 424.480402774576 | 108.482142857143 |
| FP1 | FP3 | 371.281029992557 | 319.846025386996 | -162.692307692308 |
| FP1 | FP4 | 424.906365267116 | 231.680554971727 | -140.625000000000 |
| FP1 | FP5 | -17.941410770016 | 378.234352107753 | 116.250000000000 |
| FP1 | FP6 | 13.4090909090909 | 19.1818181818182 | 0 |
| FP1 | FP7 | 377.499197595105 | 68.4734974462556 | -113.967391304348 |
| FP2 | FP3 | 375.644855953678 | 19.8237262644998 | -86.6250000000000 |
| FP2 | FP4 | -73.3760000657330 | 369.620432526620 | 83.4375000000000 |
| FP2 | FP5 | 67.2815542888731 | -21.891627139874 | -9.64285714285714 |
| FP2 | FP6 | 370.195408534153 | 130.232218207684 | -108.281250000000 |
| FP2 | FP7 | 71.8672856558700 | 76.2369606783611 | -12.1875000000000 |
| FP3 | FP4 | 72.6383159639089 | -35.781672401188 | -11.2500000000000 |
| FP3 | FP5 | 368.199792903731 | 77.8223145913911 | -84.3750000000000 |
| FP3 | FP6 | -83.1906021661901 | -29.412620243678 | -8.43750000000000 |
| FP3 | FP7 | 384.032207305980 | 269.393745240466 | -163.636363636364 |
| FP4 | FP5 | 433.348691944002 | 126.309252848132 | -112.500000000000 |
| FP4 | FP6 | 24.2584928961273 | 324.011652900537 | 108 |
| FP4 | FP7 | -54.3600000000000 | -28.0800000000 | 0 |
| FP5 | FP6 | 328.697421801577 | 75.1676233066336 | -105 |
| FP5 | FP7 | 473.606728551953 | 123.000660181383 | -115.875000000000 |
| FP6 | FP7 | 378.972600354931 | 72.2662175305872 | -115.147058823529 |

Part 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **FP** | **FP** | Distance | Angle | Pair points | Unpair point |
| FP1 | FP2 | 12 | 12 | 10 | 63 |
| FP1 | FP3 | 12 | 12 | 4 | 78 |
| FP1 | FP4 | 12 | 12 | 8 | 77 |
| FP1 | FP5 | 12 | 12 | 0 | 64 |
| FP1 | FP6 | 12 | 12 | 28 | 47 |
| FP1 | FP7 | 12 | 12 | 8 | 74 |
| FP2 | FP3 | 12 | 12 | 6 | 67 |
| FP2 | FP4 | 12 | 12 | 2 | 74 |
| FP2 | FP5 | 12 | 12 | 0 | 66 |
| FP2 | FP6 | 12 | 12 | 2 | 74 |
| FP2 | FP7 | 12 | 12 | 6 | 67 |
| FP3 | FP4 | 12 | 12 | 4 | 81 |
| FP3 | FP5 | 12 | 12 | 0 | 64 |
| FP3 | FP6 | 12 | 12 | 4 | 81 |
| FP3 | FP7 | 12 | 12 | 2 | 80 |
| FP4 | FP5 | 12 | 12 | 0 | 67 |
| FP4 | FP6 | 12 | 12 | 4 | 78 |
| FP4 | FP7 | 12 | 12 | 64 | 24 |
| FP5 | FP6 | 12 | 12 | 0 | 67 |
| FP5 | FP7 | 12 | 12 | 0 | 64 |
| FP6 | FP7 | 12 | 12 | 6 | 79 |

The average number of minutiae points paired is 7.52. I finally decide to use the distance of 12 and rotation of 12 (degree) as my threshold to find paired points. In the beginning, I choose 50 and 50 as my threshold of distance and rotation, but I think 50 is too big and it will not be accurate enough. Therefore, I keep decreasing a little bit for many times to find the threshold that have the best performance. I found that when the threshold is between 10 and 15, it will have the most proper number of pairing points (not too big nor too small) and have the best ability to distinguish if the two fingerprints are from the same person. Finally, I choose 12 to be my threshold to find the paired points.

Based on the pairing results, I think fingerprint 1 and fingerprint 6 are from the same individual. Fingerprint 4 and fingerprint 7 are from the same individual. If there are more than 12 pairs of minutiae of the two fingerprints, it is very possible that the two fingerprints are from the same person. Fingerprint 1 and 6 have 28 pairing points, which means there are 14 pairs of minutiae, and Fingerprint 4 and 7 have 64 pairing points, which means there are 32 pairs of minutiae. Therefore, I think fingerprint 1 and 6, fingerprint 4 and 7 are from the same person.