Hand Geometry Recognition based on optimized K-Means Clustering and Segmentation Algorithm

Saravanan.N
P.G Scholar, VLSI Design, PSNA College of Engineering and Technology, Dindigul, Tamilnadu, India
Email: nsaravananece@gmail.com

Abstract - Biometrics plays an important role in electronic authentication based on biological features of the human beings like hand geometry, palm print, finger print, retina and face geometry. The hardware requirements of the different electronic systems that are subset of biometric systems of categories mentioned above vary significantly. The power consumption increases with the hardware complexity used. Large power consumption leads to less portability which is not desired. Most biometric recognition systems require complex optical systems for properly capturing data without noise. The digital pre-processing of input image is an added advantage. Hand Geometry Recognition is the simplest and robust recognition system among all other recognition methods available. Hand geometry recognition involves extracting the hand which is the foreground from the background using segmentation process. Several segmentation algorithms are available. K-Means algorithm is one of the algorithms. In this work the K-Means algorithm is optimized to be used in the recognition process.

Keywords - K-Means algorithm, Biometric recognition system, Hand Geometry recognition, Robust recognition system.

1. Introduction:

Biometric recognition systems provide added security to existing systems based on using the strings as passwords. String based passwords pose a severe security threat. It has been a big challenge for software engineers to prevent online hacks. Biometric feature of one person cannot be imitated by any other person. So hacking a biometric system naturally becomes difficult. So string based systems together with biometric systems provide the best security. In this work hand geometry recognition system that can easily provide added security with string based authentication is proposed.

2. Related Work:

An objective evaluation of the eye tracking effects, its specification and stimulus presentation on the biometric viability of complex eye movement patterns was presented in [1]. Acceptable conditions under which to capture eye movement data is calculated based on Six spatial accuracy tiers (0.5°, 1.0°, 1.5°, 2.0°, 2.5°, 3.0°), six temporal resolution tiers (1000, 500, 250, 120, 75, 30 Hz), and five stimulus types (simple, complex, cognitive, textual, random) . Imaging equipments with least 0.5° spatial accuracy and 250 Hz temporal resolution for biometric purpose were used whereas stimulus had little effect on the biometric viability of eye movements.

Decision environments with a clear separation between genuine and impostor matching scores is required for biometric systems. However, the images will be degraded and the decision environments poorly separated in certain biometric applications. An indexing/retrieval method for degraded images operating at the code level, making it compatible with different feature encoding strategies is described in [2]. The position in an n-ary tree determined gallery codes are decomposed at multiple scales according to their most reliable components at each scale. The multiscale centroids are used to penalize paths in the tree during retrieval. The traversal up to the last branch is done only for the last level. When compared with related strategies, themethod particularly in the performance range most important for biometrics (hit rates >0.95) outperforms them on degraded data. The number of enrolled identities above which indexing is computationally cheaper than an exhaustive search is determined.

Hardware provides secure storage mechanisms or hardware acceleration and the algorithms are run using a software [3]. While developing application, the implications of a biometric identifier is severe for the application provider and perhaps even more so for the end user. A retinal image or other biometric feature can be replaced whereas a fingerprint or retinal image cannot be replaced. When designing applications for biometric purposes several factors are to be taken into account.

3. K-Means Clustering Algorithm:

The K-Means clustering algorithm groups the pixels in the input image into k categories based on the intensity values of the pixels. Initially k centroids are chosen for each cluster. An arbitrary data point whose value is more near to the centroid of a particular cluster than the centroid of any other cluster is categorized into the cluster with minimum difference between the pixel value and centroid of the two. The choice of a centroid is chosen such that all the centroids are at a maximum possible distance from each other. The choice of a particular value of centroid is highly ambiguous. The algorithm can be optimized to get the optimized K-Means clustering algorim.

4. Optimized K-Means Clustering Algorithm:

The proposed optimized K-Means clustering algorithm optimized to find proper centroids of the cluster is shown in the flowchart in Figure 1.The algorithm is very similar to K-Means clustering algorithm except the fact that Eigen Values are computed for the matrix. The Eigen value can be considered as a multidimensional vector which is a point in the multidimensional imaginary plane. When the transformation matrix is multiplied by Eigen Vector the centroids move away in such a way that all the centroids are as far as possible. The K-Means algorithm is run using the computed centroids. Since the centroids are pre-computed strategically rather than choosing arbitrary assignments as initial values the K-Means algorithm converges quickly and runs faster. The segmentation is also fairly good.

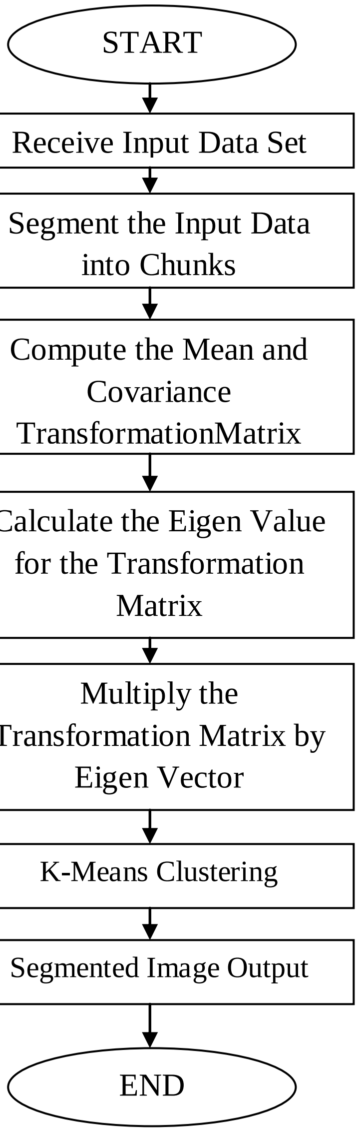

Figure 1 Flow Chart of the proposed Optimized K-Means Clustering Algorithm

5. Simulation Results:

The simulation result of the proposed algorithm is shown in Figure 2. The simulation time is estimated on the Pentium Dual-Core CPU operating at 2.80 GHz, with a RAM of 3 GB in a machine with x86 architecture.

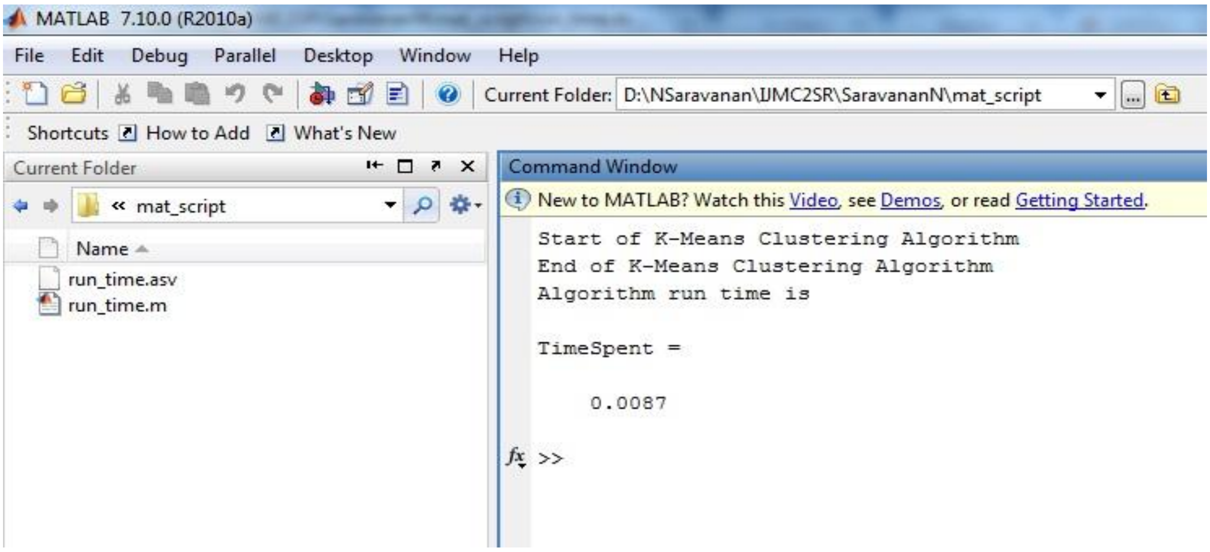

Figure 2 Run time of the proposed K-Means Clustering Algorithm

6. Conclusion:

The simulation results clearly show that the algorithm takes only tens of milliseconds to get executed. The algorithm can hence be used in real time applications. By suitable optimization of the eigen value computation units the speed of the algorithm can be further boosted up.

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