ENHANCED ONLINE SIGNATURE VERIFICATION USING IMPROVED DTW AND FUSION WITH VQ

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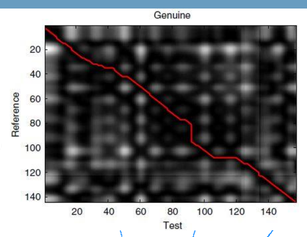
ABSTRACT

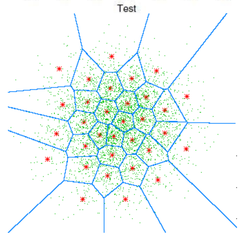
We present a system for online handwritten signature verification based on pattern recognition algorithms DTW (Dynamic Time Warping) and VQ (Vector Quantization). Traditional DTW implements point to point matching and calculates the minimum distance path. Our proposal is to consider the context around the point and match it as a segment rather than a single point. And in DTW, only the minimum distance is used and the warping path is not considered. Our improvement is that to add a penalty term to the segments matched which in DTW and are not in the same cluster calculated by VQ We present the results on the signature database SVC-2004. The signatures are acquired using a digitized tablet which captures both dynamic and spatial information of the writing.

BACKGROUND

DTW is a template matching method which is commonly used in signature verification. In DTW the input and reference signatures are compared by using a dynamic programming strategy that can manage the variability on the signature's length.



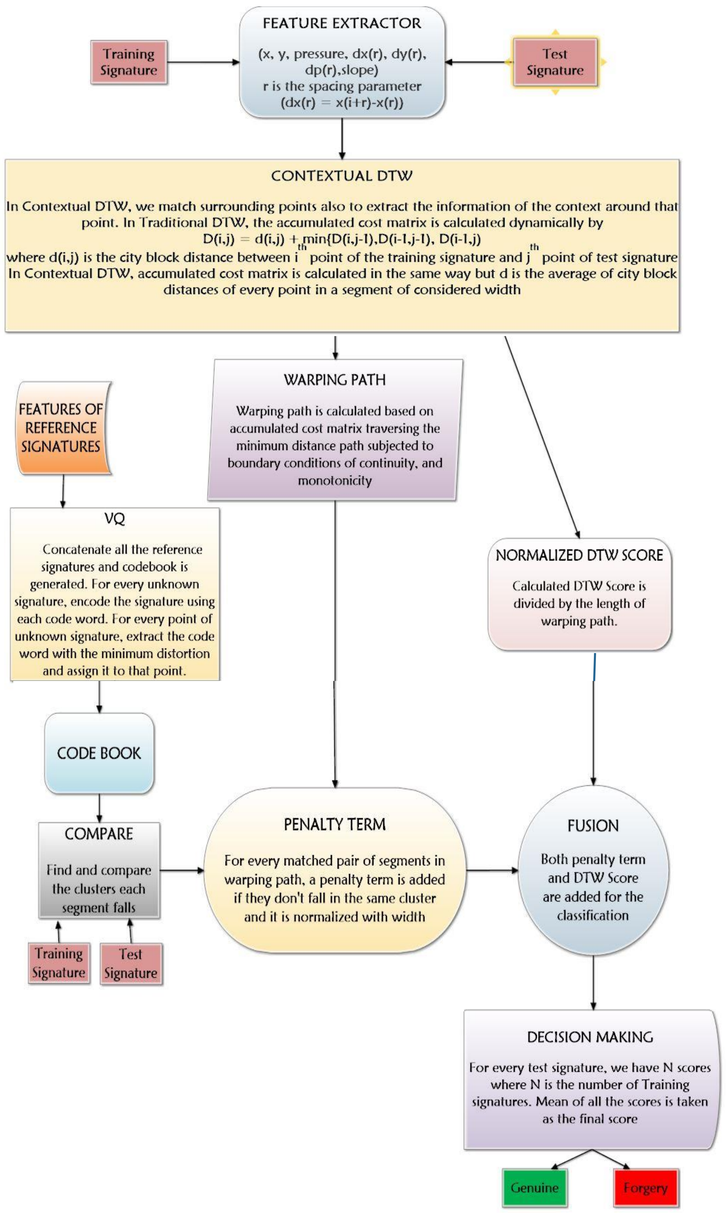
Vector quantization is a classical quantization technique used in many applications such as image and voice compression. A vector quantizer maps k-dimensional vectors to a finite set of vectors. Each vector is called a code word and the set of all the code words is called a codebook.



OBJECTIVES

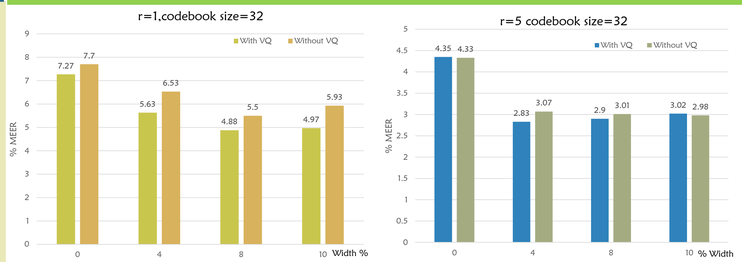
- To improve DTW by considering segment matching rather than point to point matching
- Fuse the normalized DTW score with VQ by adding a penalty term considering the dynamic warping path
- Vary the set of features and parameters to find the best suit. Parameters include spacing parameter first order difference, codebook size, number of training signatures

MODEL

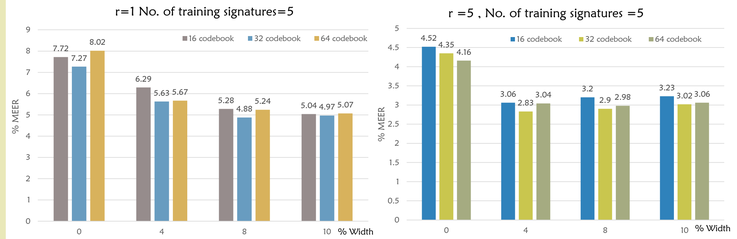


Block Diagram of proposed Verification System.

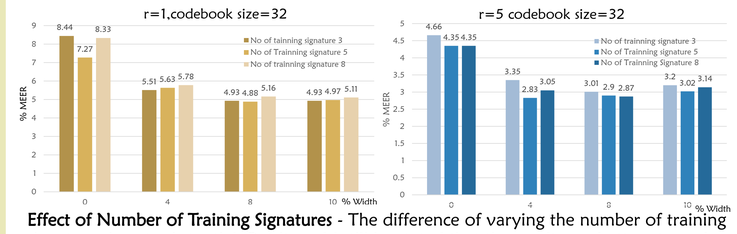
RESULTS



Effect of VQ and r - The effect of VQ is more prominent at r=1 than r=5. At r=1, adding penalty term improved result up to 0.9 percent on an average for contextual DTW and 0.5 percent for Traditional DTW. At r =5, the change is negligible. And it can be seen that increasing r improves the result substantially. 3-4% improvement can be observed in both Traditional and Contextual DTW. The difference between Traditional and Contextual-DTW is also considerable. Contextual DTW improves the MEER more than 2 percent at r=1 and more than 1 percent at r=5.



Effect of Codebook size - Codebook size of 32 is experimentally found to be the best suited for this database. Optimum codebook size depends on the number of points in the user's signature.



Effect of Number of Training Signatures - The difference of varying the number of training signatures is not substantial. But it could still be stated that the results are better at number of training signatures is equal to 5.

CONCLUSIONS AND FUTURE RESEARCH

- We presented a novel online signature verification strategy, enhanced the DTW and fused with VQ. We have improved the results significantly by considering the context around the point for matching. By adding the VQ, we have improved the performance of both traditional and contextual DTW. In adding the VQ, we have explored the warping path of the DTW. By varying the spacing parameter r, we have improved the result considerably.
- We have worked on MCYT-100 database along with SVC database. With same set of features and procedure, we have achieved preliminary results which are better compared to the state of art methods. The best result for MCYT is 1.15 percent and we have achieved MEER up to 0.9 percent. We would want to explore more on that database.
- Since we have already explored many dimensions of our method, we would like to start at some new ideas. Or we could improvise our method more, we could add better features, probably some global features. As of now, the effect of VQ is not that high compared to context and spacing parameter r. We could work on improving the fusion of DTW and VQ.