DSAA Project Summary Report (Group 42)

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Topic:

Degraded quality fingerprint enhancement using MATLAB.

Findings of the Project:

Fingerprint enhancement aims to improve the clarity of ridge structures of fingerprint images in recoverable regions and to remove the unrecoverable regions. During the processing of each pixel we are considering a local neighbourhood of that pixel. Directional filters are used as the ridges and valleys have well-defined frequency and orientation in the local area. Here the filtering process is adaptive as the parameters of these directional filters depend on the local ridge frequency and orientation. So, in frequency domain, directional filters are used for fingerprint enhancement. The main steps of the algorithm include:

1. Normalization
2. Local orientation estimation
3. Local frequency estimation
4. Region mask estimation
5. Filtering

Analysis of the Result:

Taking the following degraded fingerprint image as the input image:

The output of fingerprint enhancement is as follows:

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The SSIM value is 0.8543.
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Analysis:

- After undergoing normalization, orientation estimation, frequency estimation, region mask estimation and filtering, the fingerprint is enhanced.
- It can be seen that most of the ridges in the recoverable regions have been recovered.
- To the naked eye, it can be seen that the output image seems very similar to the input image.
- To further verify the output, SSIM index is used.
- This is done by taking a good quality fingerprint image, adding noise to it, and then enhancing it. Now SSIM index is used to compare the enhanced image and the original good quality image.

Difficulties faced:

- Improving the accuracy of enhancement.
- Calculating the accuracy of the enhanced image.

Resolving the difficulties:

- It was seen that while dividing the image into blocks, reducing the block size improved the efficiency and accuracy. The reasoning behind this was that reducing the block size meant dealing with less noise.

- Accuracy could also be improved by changing the threshold value. By changing the threshold value from 1 to 0.01 it was seen that the algorithm yielded better results.
- Initially there was no way for us to measure the accuracy, i.e. we did not know how to get a number or percentage depicting the accuracy of our code. After a few discussions we came to a conclusion that if we take a good quality fingerprint image, add noise to it and enhance the poor-quality image, there must be a way to compare the enhanced image and the original image. Then we decided to use SSIM index to measure the accuracy. SSIM does a pixel be pixel comparison of two images and gives a number less than or equal to 1 indicating the similarity between the two images.