Lossless Compression of Polar Iris Image Data

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Motivation

- The compression of biometric sample data may become imperative under certain circumstances due to the large amounts of data involved, e.g. in distributed biometric systems. Optimal compression is important to minimize effects on matching accuracy.
- **Lossy compression** techniques maximize the benefit in terms of data reduction. However, the distortions introduced by compression artifacts may interfere with subsequent feature extraction and may degrade the matching results.
- **Lossless compression** avoids any impact on recognition performance but is generally known to deliver much lower compression rates. An additional advantage of lossless compression algorithms is that these are often less demanding in terms of required computations as compared to lossy compression technology (which is bene cial for the sketched target-scenario often involving weak or low-power sensing devices).

Compression in Biometrics

- ISO/IEC 19794 standard on "Biometric Data Interchange Formats": current version supports JPEG and JPEG2000 (and WSQ for fingerprints) for lossy compression and JPEG-LS for lossless compression. The most recent (draft) version (ISO/IEC FDIS 19794-6 as of August 2010) supports only JPEG2000 for lossy compression and **PNG for lossless compression**. The latter draft is mostly based on the NIST Iris Exchange (IREX) program recommendations.
- ANSI/NIST-ITL 1-2011 standard on "Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information": for lossy compression JPEG2000 is supported, and **JPEG2000 as well as PNG for the lossless case**.

Applied Compression Algorithms

- Lossless image compression algorithms: lossless JPEG, JPEG-LS, GIF, and PNG.
- Lossy image compression algorithms in lossless mode: JPEG2000, SPIHT, and JPEG XR.
- General purpose lossless file compression algorithms: 7z, BZip2, Gzip, ZIP, UHA.

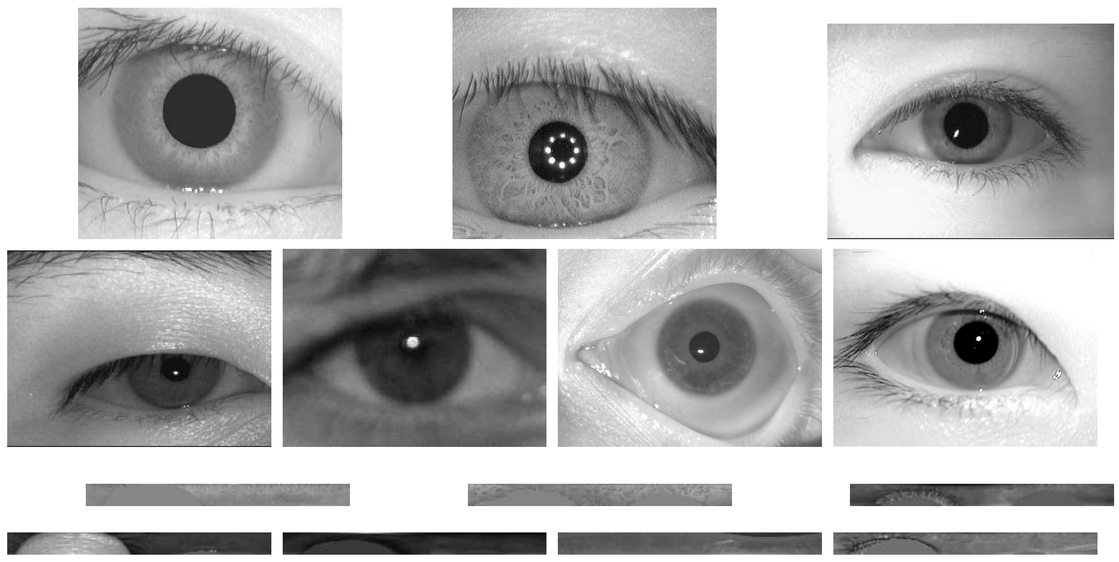
RESEARCH QUESTION: Are the standardised algorithms the best choice ?

Sample Data

For all our experiments we used the images in 8-bit grayscale information per pixel in .bmp format since all software can handle this format (except for SPIHT which requires a RAW format with removed .pgm headers), colour images have been converted to the YUV format using the Y channel as grayscale image.
Databases: CASIA V1, CASIA V3 Interval, MMU, MMU2, UBIRIS, BATH, and ND Iris.

Polar Iris Images

We convert the rectilinear iris images to polar iris images (240×20 pixels), which correspond to iris texture patches in polar coordinates which are obtained after iris segmentation and log-polar mapping. An open-source MatLAB iris-recognition implementation is applied for this purpose.



Experimental Results: Compression Ratio

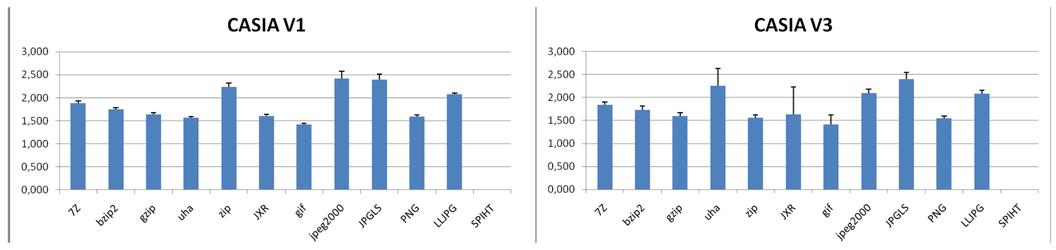


Fig. 1 CASIA V1 and V3 datasets.

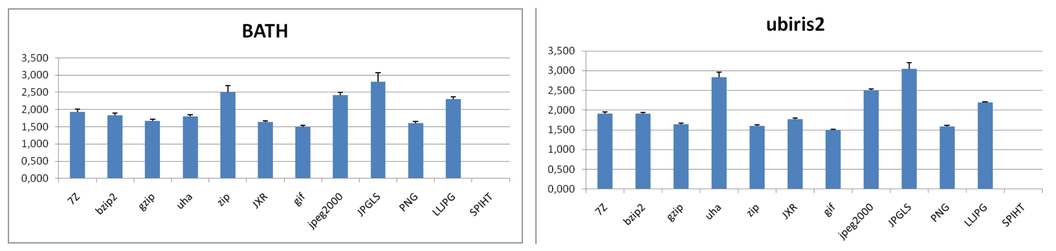


Fig. 2 MMU and ND Iris datasets.

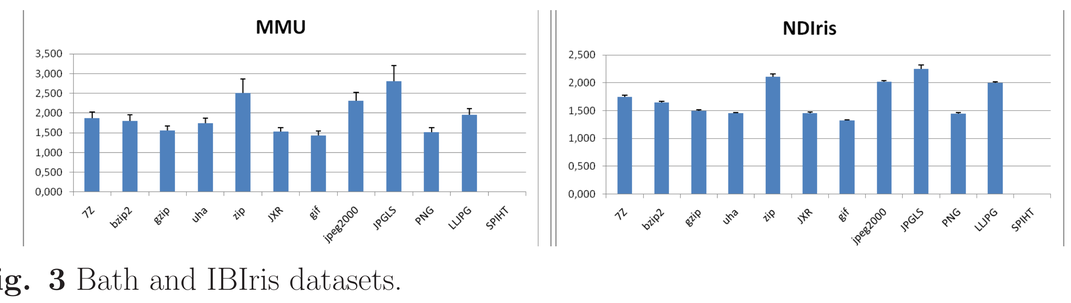


Fig. 3 Bath and IBIris datasets.

CONCLUSION

- **JPEG-LS is found to be the top performing algorithm for all but one dataset.**
- **PNG, although found in two most recent biometric standards, is consistently ranked second-worst only superior to GIF.**

$\longrightarrow$ from the algorithmic viewpoint, JPEG-LS is the ideal choice for the target application scenario offering excellent compression rates and moderate computational cost. The decision to standardise PNG in this context should be reconsidered based on the results of this study.