Offline Signature Verification Based on Bag-of-Visual Words Model Using KAZE Features and Weighting Schemes

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1 Motivation

1. Technical issues

   Feature extraction from a whole signature

➡ **WEAKNESS**: global shape variation, missing part of strokes

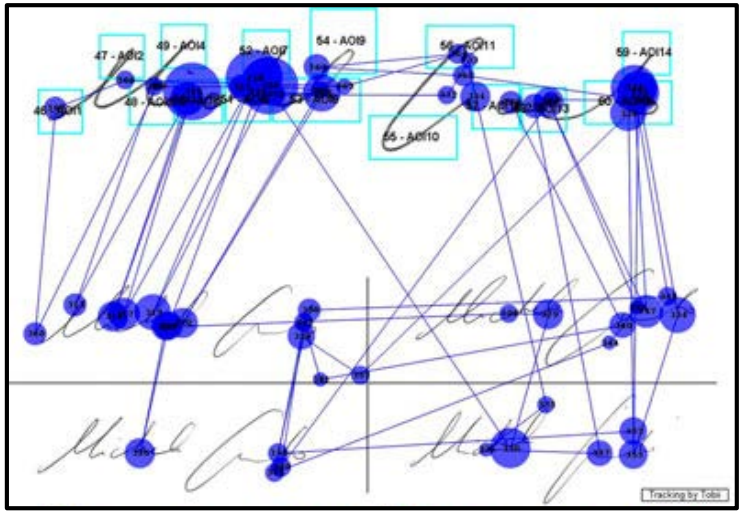
2. Improvements

   Experts focus on salient parts ➡ Bag-of-Visual Words

Experts' eye movements

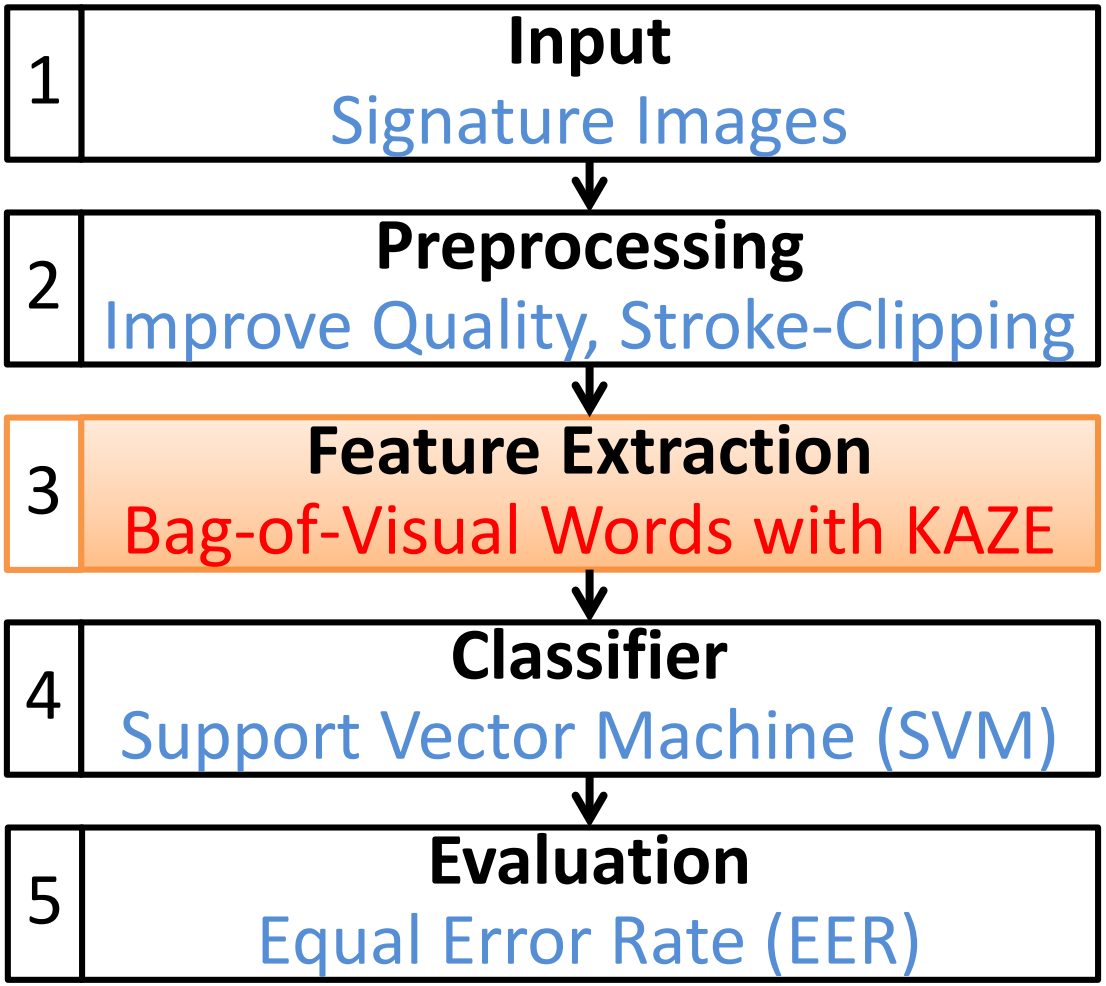
Eye-gaze tracking technology

Upper: a disguised signature
Lower: four genuine signatures

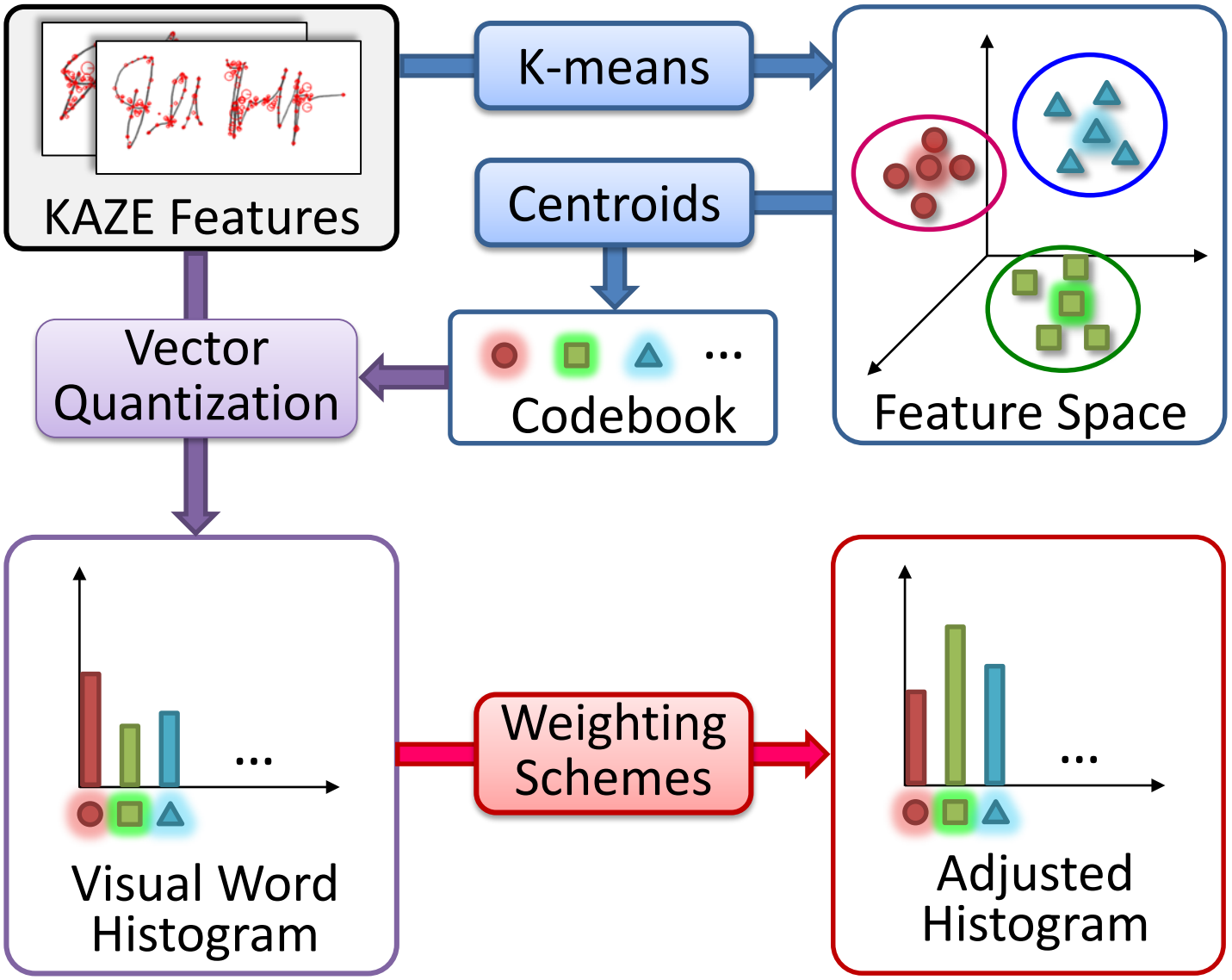


Quoted from Fig. 3(A) in [5]: A.G. Dyer et al., "An insight into forensic document examiner expertise for discriminating between forged and disguised signatures," J. Forensic Sciences, 53(5):1154-1159, 2008.

2 Proposed Method: Outline



2 Proposed Method: Bag-of-Visual Words

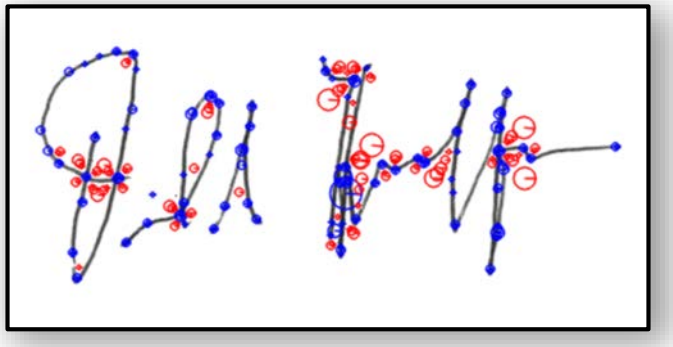


2 Proposed Method: KAZE Features

- Scale- and rotation-invariant detectors/descriptors in nonlinear scale spaces
- Reserving the natural stroke boundaries compared to Gaussian scale space-based methods

Detected from
strokes
+ **background**

Considering information of
strokes themselves
+ **relations between strokes**



- KAZE from strokes
- KAZE from background

2 Proposed Method: Weighting Schemes

Weighting Schemes	Consider the importance of each visual word for verification

How common
a local feature *t* is
across all the *N* signatures

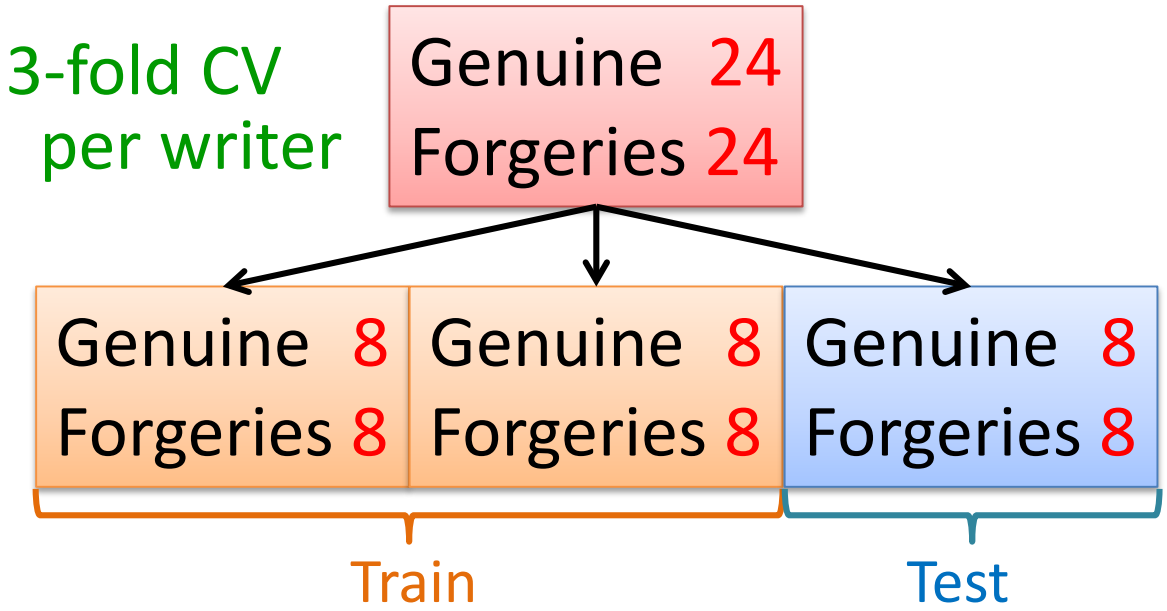
tf	df	Normalization
$1 + \log(tf_{t,d})$	$\log \frac{N}{df_t}$	$\frac{1}{\sqrt{w_1^2 + \ldots + w_M^2}}$

How frequently
a local feature *t* occurs
in a signature *d*

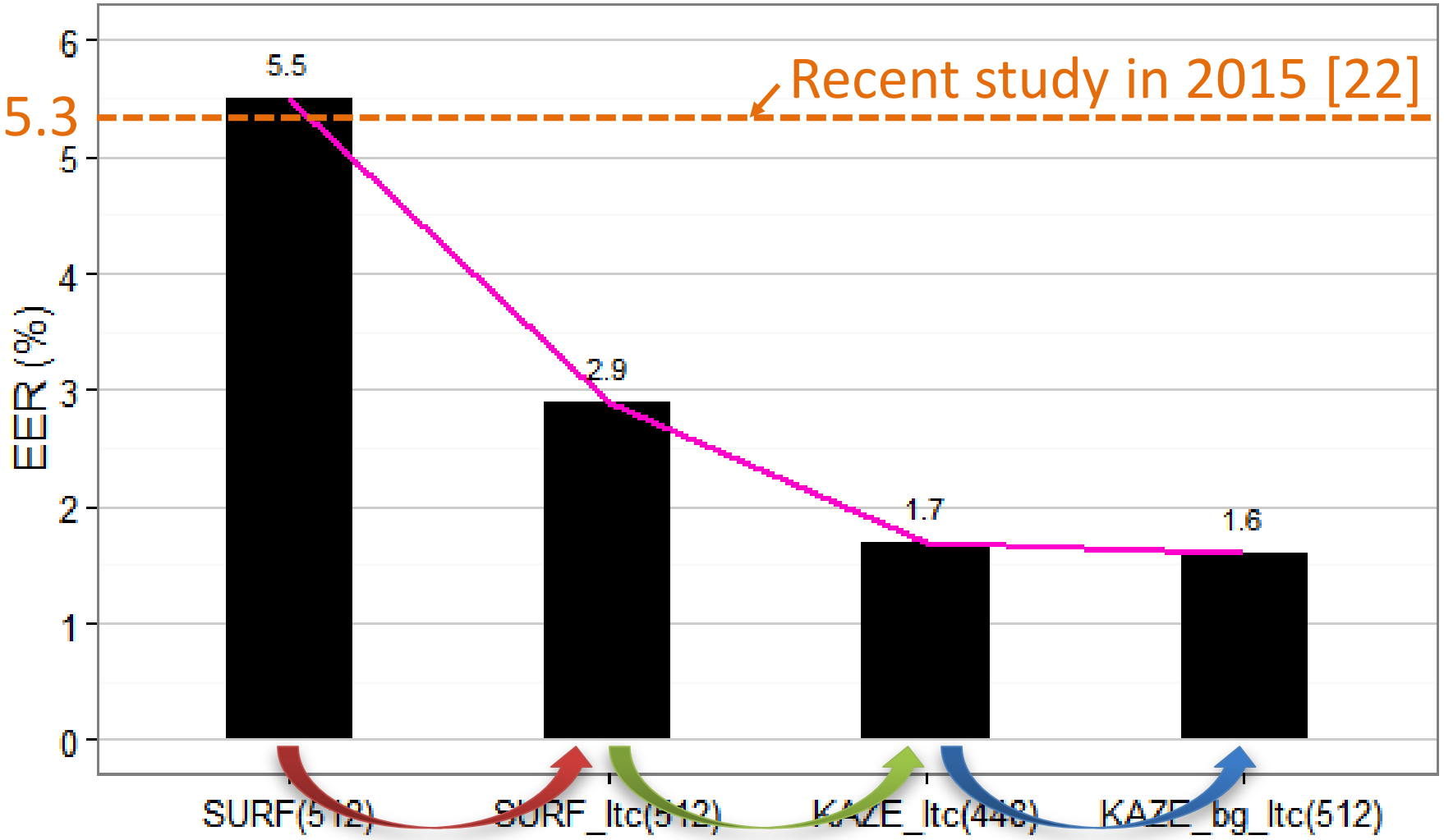
Eliminate
stroke length differences
between signatures

3 Experiments: Conditions

- CEDAR signature dataset (in English)
- 55 volunteers
  (24 genuine, 24 skilled forgeries per writer)
- 8-bit gray-level images at 300 dpi



3 Experiments: Results



4 Conclusion

Bag-of-Visual Word Model
Cognitive processing of FDEs

KAZE Features
Contour information of strokes

Weighting Schemes
Importance of each visual word

Decrease error rate from recent 5.3% to proposed 1.6%

Strength

1) global shape variation
2) accidentally missing of a part of strokes

Acknowledgment

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