AN ANNOTATION-FREE METHOD FOR EVALUATING PRIVACY PROTECTION TECHNIQUES IN VIDEOS

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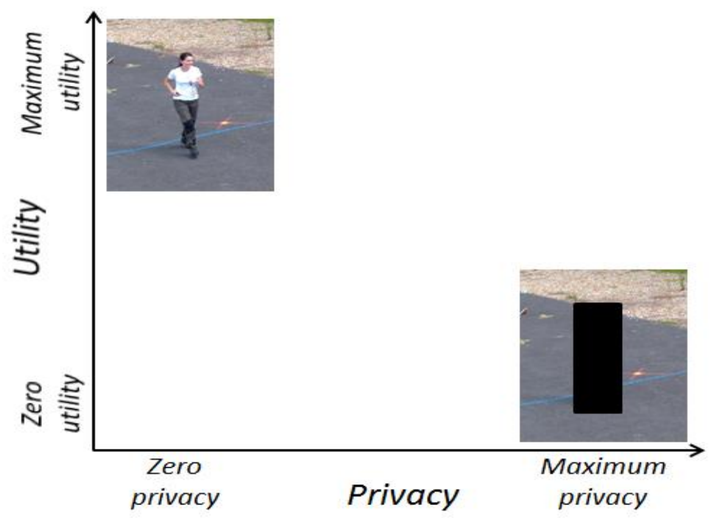
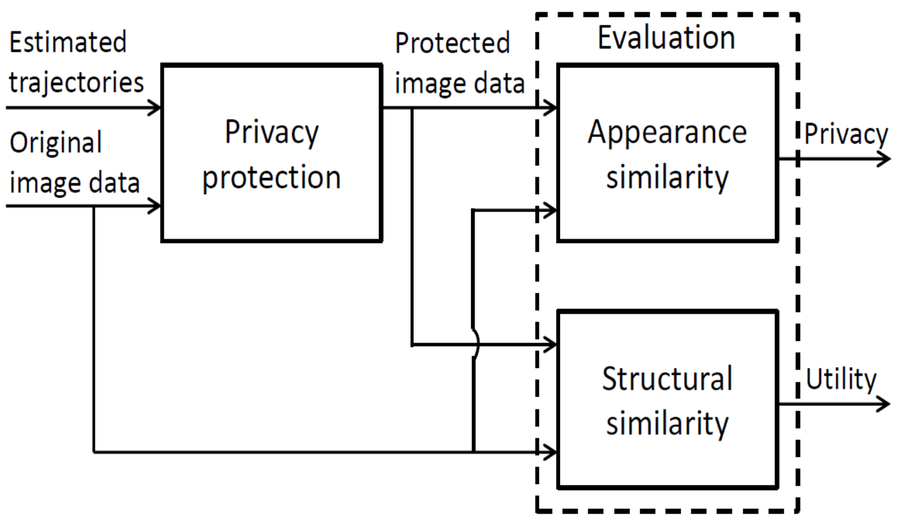
1. Introduction

- Absence of an annotation-free method to evaluate privacy protection techniques
- Existing methods
  - Rely on subjective judgements [1, 2]
  - Assume the presence of a specific target type in an image [3]
- Key aspects of evaluating a privacy protection methods [2, 4]
  - Privacy → the extent of information hidden
  - Utility → the preservation of structural/behavioral information
  - Determining privacy *vs*. utility trade off



2. Proposed evaluation method

- Trajectory *j*: sequence of bounding boxes estimated by a tracker for a target *j* across a sequence



- **Privacy (P_k)** is computed as an appearance similarity between privacy-protected bounding boxes ($B'_{k,j}$) and corresponding original bounding boxes ($B_{k,j}$) at a frame *k*

$$P_k = \frac{1}{n_k}\sum_{j=1}^{n_k} D_{k,j}(q^{B_{k,j}}, q^{B'_{k,j}}),$$

$D_{k,j}(.)$ → Bhattacharyya distance; $q^{B_{k,j}}$→ PDF for $B_{k,j}$; $q^{B'_{k,j}}$→ PDF for $B'_{k,j}$; n_k → no. of targets

Overall achieved privacy across all *K* frames of a sequence: $\mathrm{P} = \frac{1}{K}\sum_{k=1}^{K} P_k.$

- **Utility (U_k)** is computed as a structural similarity between $B'_{k,j}$ and corresponding $B_{k,j}$ at a frame *k*

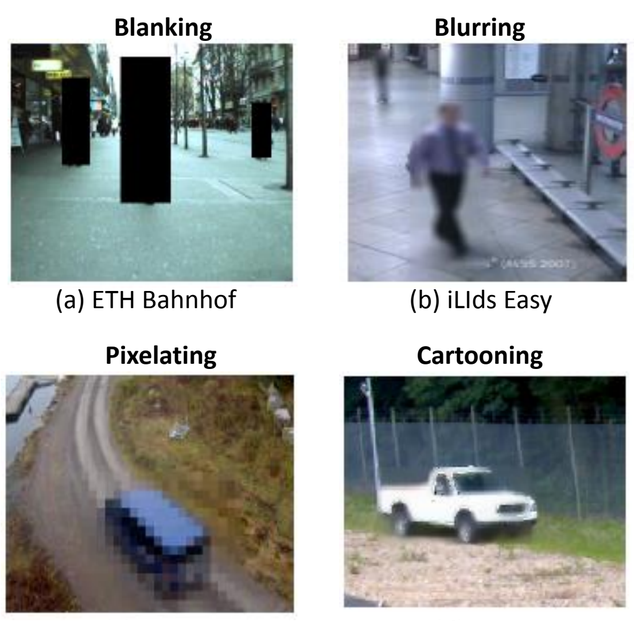
$$U_k = \frac{1}{n_k}\sum_{j=1}^{n_k} \mathrm{MSSIM}_{k,j}(B_{k,j}, B'_{k,j}),$$

$\mathrm{MSSIM}_{k,j}(.)$ → Mean Structural Similarity Index [5] that was also used in [4, 6]

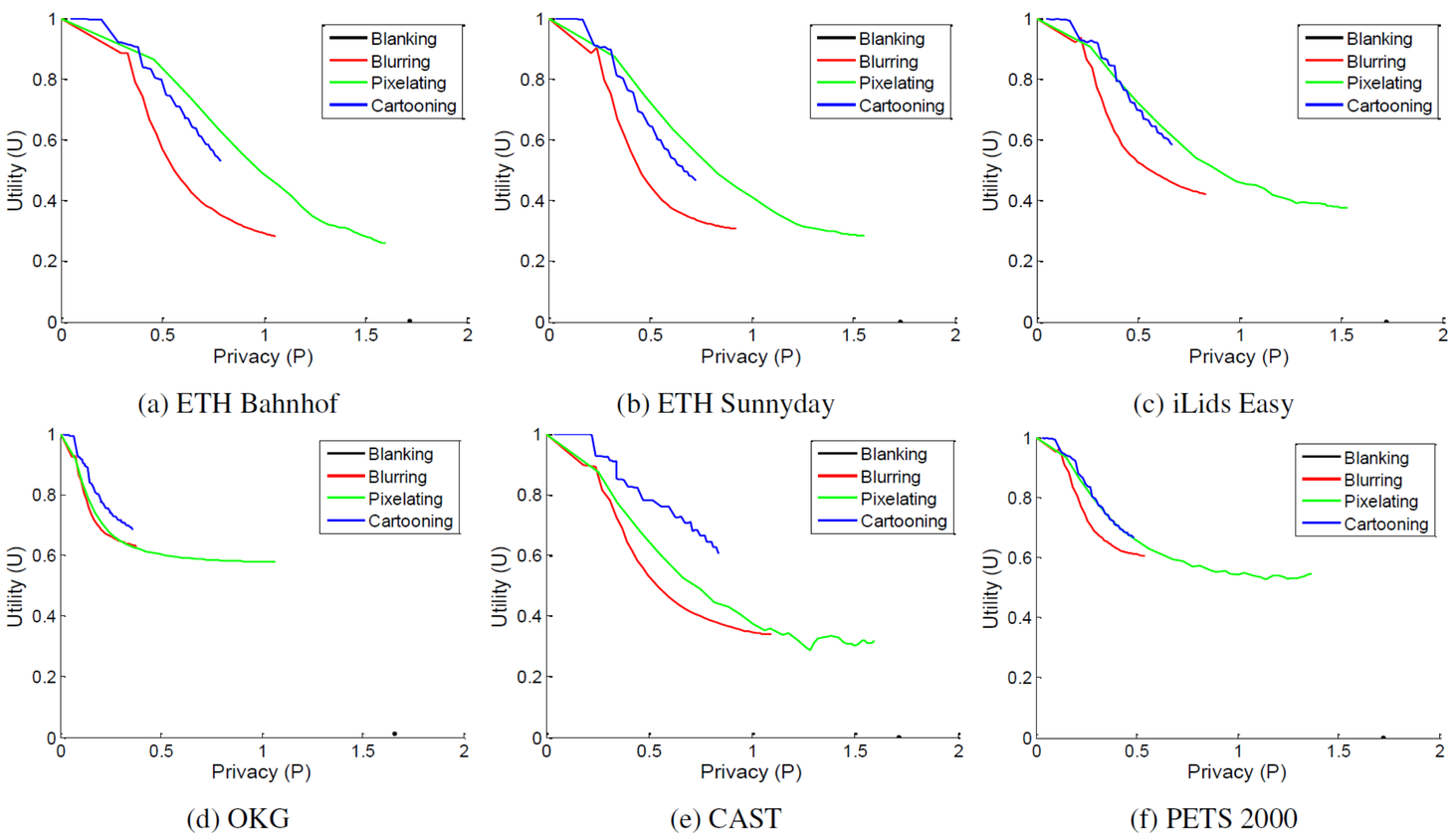
Overall achieved utility across all *K* frames of a sequence $\mathrm{U} = \frac{1}{K}\sum_{k=1}^{K} U_k.$

3. Experimental results

- Privacy protection techniques
  - Blanking
  - Blurring
  - Pixelating
  - Cartooning



Sample qualitative results for different privacy protection techniques



Utility score (U) plotted vs. privacy score (P) for different privacy protection techniques for a variation of filter intensity on all datasets (ETH Bahnhof, ETH Sunnyday, iLids Easy, OKG, CAST, PETS 2000)

4. Conclusions

- Annotation-free and target-independent evaluation method for privacy protection techniques
- Evaluates privacy and utility aspects
- Blanking is not desirable as it provides a low utility
- Pixelating is found to provide a better utility-privacy trade off on datasets with person target
- Cartooning is found to provide a better utility-privacy trade off on datasets with vehicle target

References

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Acknowledgement

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 312784.