MediaEval 2013 Visual Privacy Task: Pixel Based Anonymisation Technique

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ABSTRACT

In this paper, a pixel-based method for personal anonymisation in visual surveillance applications, is presented. The proposed method tries to tackle the problem of balancing the intelligibility with privacy, by including some form of contextual information in the anonymisation process. Objective and subjective evaluations show promising results in intelligibility and appropriateness, but they also show that privacy could be further improved.

1. INTRODUCTION

Proactive efforts to ensure citizens' security lead to widespread adoption of invasive video surveillance systems. The ever-increasing amount of recorded information poses a direct threat to citizens' privacy and their right to preserve their personal information. Thus, a general social concern has emerged for the loss of privacy, demanding new approaches to preserve and protect it, ensuring their anonymity and freedom of action whilst maintaining the surveillance performance. We propose a new approach to preserve persons' identity in visual surveillance information for the MediaEval Privacy Task [5]. The proposed approach tries to balance the privacy and the intelligibility of the scene by combining different filters for different parts of the scene. Both objective and subjective evaluations show promising results in intelligibility and appropriateness, but a low score in privacy shows there is still room for improvement of the filter. The rest of the paper is organised as follows: Section 2 presents the proposed method, the objectives and design choices behind it's development. Section 3 presents the evaluation of the method using both objective and subjective metrics. Finally, section 4 draws some closing remarks and states future research opportunities.

2. PROPOSED METHOD DESCRIPTION

When designing the anonymisation method, the main goal is to maximise the privacy of the person while maintaining a very good intelligibility. With this in mind, we listed the possible types of ROIs and the information they carried to identify a person. After this, we classified the possible types of Regions of Interest (ROIs) into three categories, each category containing more information than the previous.

The core of the method applies a pixelisation filter to all ROIs, but additional steps are performed to each "level", becoming more and more specific in the type of filter applied. The description of the different levels and the filters applied are described in the following subsections, followed by a brief discussion of the method.

2.1 Accessories and Hair

This level carries the less information about the person being anonymised, so the more general filter is applied in this step, which is the pixelisation filter. In our tests, a pixel size of 24x24 yielded the best results for the presented scenarios, but different conditions might need a different pixel size, and the proposed method is flexible enough to allow a different pixel size via a parameter, so it could be changed easily to adapt to a different scenario.

2.2 Skin Regions

In this step, a skin colour detector in the *hue, saturation, and value* (HSV) colour space is used to detect and change the subject's skin. We used a fixed range in the colour space in which all pixels within this range are considered skin. Since we are only applying this to skin ROIs, the risk of false positives is low, while the amount of true positives is maximised. In our experiments, this range was $H \in [0°, 28.23°], S \in [0.04, 1], V \in [0, 1]$.

The colour of each detected skin pixel is then changed to a single colour. This ensures everyone to have the same skin colour, effectively concealing their true race. In this particular scenario, we choose the colour $(14.11°, 0.31, 0.39)$.

This step also introduces other parameters to further adapt the method to different scenarios, which are the skin detection range and the skin colour changing.

2.3 Face

The face is considered apart from the skin to improve not the privacy but the intelligibility. In this step, after the skin colour change and the pixelisation, edges of the face, detected by the Canny Edge Detector[1], are overlaid, which allows to keep some information of the subject and the class of the ROI. A final set of parameters are introduced in this step with those belonging to the Canny Edge Detector.

2.4 Method Discussion

When developing the anonymisation filter, several things were considered. Pixelisation, as the main filter, was con-

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Figure 1: Output produced by the filter.

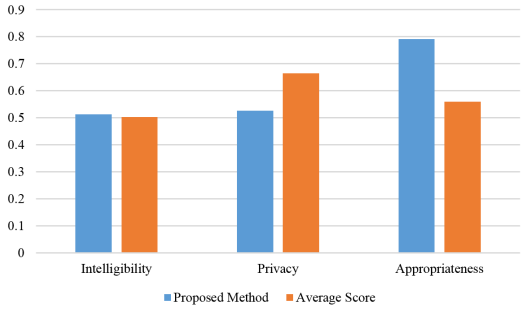

Figure 2: Objective Evaluation

sidered because it has shown to have a very good balance of privacy and intelligibility [3][4]. Additionally, Skin colour is regarded as one of the most important features when identifying humans[2], which is why an additional step was considered to conceal the person's real skin colour before the pixelisation filter. Finally, the face's edges are imposed over the colour change and pixelisation of the face ROI as a measure of intelligibility. This allows to keep some information on the subject's face while keeping his true identity concealed. Figure 1 shows an example output produced by the filter, next to the original, unfiltered ROI.

The filter was implemented in C++ using the OpenCV library for image processing and Xerces-C++ to load the ROIs from an XML file. In particular, the implementation uses the parallel programming paradigm to perform the different stages of the algorithm concurrently to achieve a near real-time performance.

3. EVALUATION RESULTS

Results of the objective and subjective evaluations are shown in Figures 2 and 3 respectively. The figure shows the score of the proposed method paired against the average score of the other methods presented in the challenge. The use of pixelisation combined with the face's edges combined paid of in the high score seen in intelligibility and appropriateness, while the change of the colour skin did not affect this measures. The evaluation results also show that there is still room for improvement in the privacy preserving aspect of the filter.

4. CONCLUSIONS AND FUTURE WORK

A pixel-based anonymisation method of visual surveillance information has been presented for the MediaEval 2013 pri-

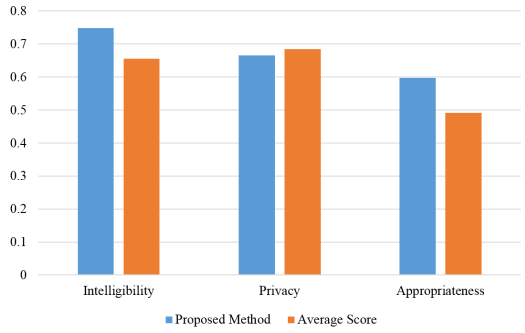

Figure 3: Subjective Evaluation

vacy task. The proposed method applies different filters depending of the level of privacy information carried in a ROI. Objective and subjective evaluations show that the filter performs very well in intelligibility and appropriateness but there is still opportunities to improve the privacy preserving aspect of the filter. Because the filter is developed in a modular way, different parts of the filter can be improved separately. The inclusion of parameters also allows to an improvement in results without modifying the method itself. For example, the pixelisation filter could produce smaller or bigger pixels. The range of colour in the colour detection, and the target colour in the skin colour change, could be all changed to include more (or less) tones of skins or to produce a darker or lighter skin tone. Finally, the Canny Edge Detection algorithm used in the face introduces it's own set of parameters to detect the edges. More advanced adjustments to the filter include the colour change part of the method. For example an advance colour transfer technique could be used to produced more natural results. The edge detection could also be improved by softening the detected edges to produce a more natural result, or using a different method to detect the edges altogether.

5. REFERENCES

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