Vision based meat tracking

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Abstract – Tracking of meat and meat products is important e.g. for documentation of origin. Today trace in slaughterhouses is depending on secondary tracking systems, like boxes or Christmas trees. In this study we use vision to identify pork loin cuts after storage overnight. An image of the inner side was used in the analysis, where we use k-means clustering to make a histogram for each image to match the samples, and it was possible to identify all 39 samples.

Key Words – Documentation, Authenticity, Pig meat, Computer vision

I. INTRODUCTION

Tracking of meat is important e.g. for documenting supplier origin and authenticity to the consumer as well as adding quality stamps. This can potentially enable consumer tracking when the supplier can document precisely which animal the meat originates from. In a slaughterhouse, the difficulty of establishing a tracking system that fulfils such requirements depends on the amount of animal slaughtering per day. To track the animal from the farm to the slaughterhouse ear tags are used, but after slaughtering and cutting another type of identification is needed [1].

Today, trace in a slaughterhouse is dependent on secondary tracking systems like boxes and Christmas trees or the use of optical sensors and shift registers to keep the identity of a piece of meat. This requires a one-to-one correspondence between the media being tracked and the meat itself, which is not always the case, accidents happen, pieces are exchanged, etc. The aim of this study is to show that it is possible to recognize an individual pork loin after storage overnight.

II. MATERIALS AND METHODS

The experiment was implemented at a commercial slaughterhouse. We chose the loin with bone and rind for our experiment. Just after carcass cutting, the backs were hung on Christmas trees for moving to the experimental room. 40 backs covering both left and right sides of the carcass were selected randomly from the line and measured twice: The day after cutting, and again 22 hours after hanging on a Christmas tree in a cooler (4°C room temperature). One back disappeared during storage, so only 39 backs were photographed after storage. Both times, the samples were measured from the inner, the outer, the belly and the backbone side, but only the inner side was used.

The still camera system was placed 1 meter above a moving conveyer. We used a Bumblebee XB3 stereo camera with 120 mm baseline[1]. The lens was 6 mm with 43 degree Field of View. Lighting was supplied through a high frequency fluorescent tube of medium intensity.

We matched two sets of images by making an image characterization, which enabled us to measure the similarity between images. The characterization is based on a histogram of image features extracted densely over the meat sample in a single image. Hereby we can measure the visual similarity of pork loin by the similarity of feature histograms.

Figure 1 illustrates the procedure. First a region of interest is found by segmenting the loin using a combined colour and texture segmentation procedure [2] followed by a morphological opening and closing. From the image segment we extract a dense set of DAISY image features [3] in every third pixel, from that we build a visual vocabulary containing 400 visual words similar to the procedure of [4]. This is made by using k-means clustering, in which the individual visual words are cluster centroids. Each feature is

[1] Note that we did not use the 3D information

assigned to a visual word by finding the nearest neighbour using the Euclidian metric.

Each image is represented by 400 visual words, which we use for constructing an image histogram. To encode spatial information we construct an image histogram as collection of eight spatially weighted histograms as illustrated in Figure 1. This final histogram is 3200 dimensions and is normalized to unit length using the L_1 norm. Hereby we can measure the similarity between images as the L_1 norm of their differences.

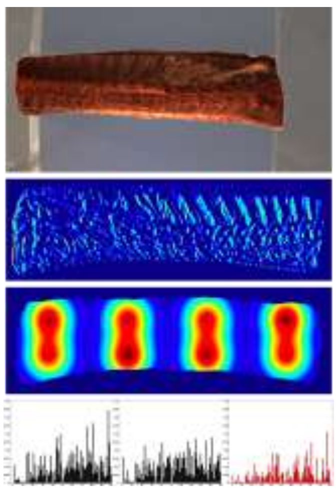

Figure 1. Illustration of the procedure.
Top to bottom is the segmentation, the DAISY features, the spatial sampling, image histograms (black) and difference between histograms (red).

III. RESULTS AND DISCUSSION

Images from the inner part of the backs with visible ribs and meat were used in the experiment. Figure 2 shows a confusion matrix of the matching with colours showing the similarity measure of the images. The confusion matrix has a clear pattern showing that each image before storage is most similar to the correct matching image after storage. Further it is found that the left and right side of the pig back is easily distinguishable using our similarity measure. This is shown in the confusion matrix as the pattern in which each image has significantly higher similarity to half of the other images.

Our method requires that the meat pieces have a unique texture pattern, here the inner part of the back, which can be seen before and after storage. So it will fail if the meat piece is turned upside down. Nevertheless, the method is invariant to rotation in the image plane. In this proof of principle study we have not investigated the robustness to light variation and misplacement of the meat. We did however loose one pig back during storage, which was no problem for the method.

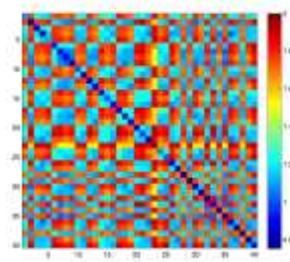

Figure 2. Matching the similarity of samples before and after storage.
Sample number 23 is missing after storage.

IV. CONCLUSION

We have suggested a method for non-contact visual meat traceability using feature based image encoding. We demonstrated the possibility of tracing 39 pig backs stored for 22 hours. Further the method provides means of separating left side from right side backs. This approach has great potential for objectively documentation of meat origin through the slaughterhouse. We expect the method to be equally applicable for other cuttings and hereby become an important tool for meat authenticity documentation.

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REFERENCES

1. Hagdrup C. (2004). Carcass identification and traceability of meat and meat products. In Jensen WK, C. Devine & M. Dikeman. Encyclopedia of Meat Sciences Vol. I, pp. 149-155. Elsevier Ltd.
2. Dahl A, Larsen R (2011). Learning dictionaries of discriminative image patches. In: Proceedings of the British Machine Vision Conference, BMVA
3. Tola E, Lepetit V, Fua P (2010). Daisy: an Efficient Dense Descriptor Applied to Wide Baseline Stereo. vol. 32, pp. 815–830
4. Sivic J, Zisserman A (2003). Video google: A text retrieval approach to object matching in videos. In:

Ninth IEEE International Conference on Computer Vision, 2003. Proceedings. IEEE, pp 1470–1477