Automatic cattle identification using graph matching based on local invariant features

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ABSTRACT

Cattle muzzle classification can be considered as a biometric identifier important to animal traceability systems to ensure the integrity of the food chain.

This paper presents a muzzle based classification system that combines local invariant features with graph matching in a three step approach: feature extraction, graph matching, and matching refinement.

The results proved that our proposed method achieved high accuracy even if the testing images are rotated in several angles.

CONCLUSIONS

The proposed method is robust from three perspectives. First, it uses the robustness of the SIFT features to image scale, shift, and rotation. Second, it uses a graph matching technique that preserves the node structure of the features. And third, it uses the MLESAC algorithm as a robust outlier detector for refining the graph matching results and ensure the robustness of the matching process. The results proved that our method achieved good results even if the images are rotated in several angles.

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Introduction

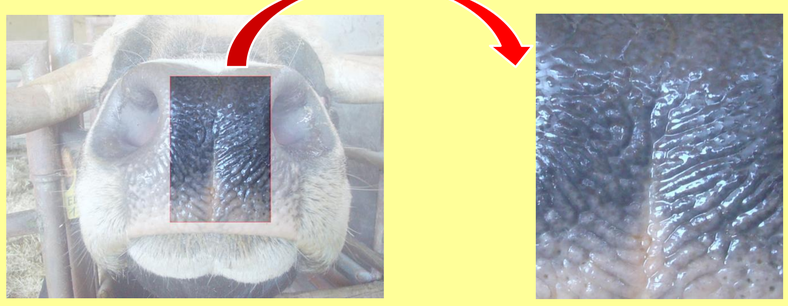
Cattle identification and traceability plays an important role for disease control, vaccination management and also for maintaining consumer confidence in farm produce. The approach for beef cattle identification should be guaranteed to be permanent, difficult to faked, easy to acquire, inexpensive, accurate and humane. The use of biometric identification methods is less prone to errors and frauds and should be explored.

The muzzle patterns of cattle are the uneven patterns on the surface of the skin of the nose. As fingerprints are unique to human beings, the ridges and valleys of each cow's muzzle form a pattern that is likewise unique to each animal.

Materials and Methods

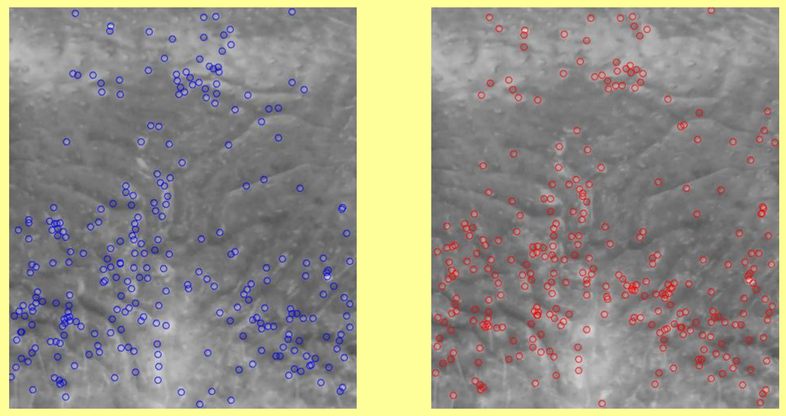
Data Acquisition

The images have been collected from 15 animals with 5 muzzle images each. Four of the collected muzzle photos of each individual are used as the training data, rotated 20º to each side, and the rest is used as the testing data. In every muzzle photo, a rectangle region centered between the nostrils is taken as the region of interest (ROI).



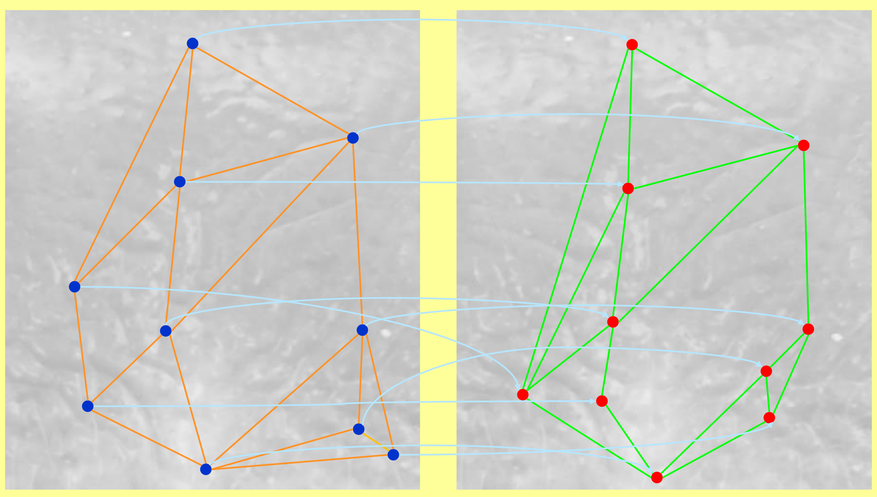
Local Invariant Features Detection

SIFT generates attributes representing neighbor texture around the feature points. To ensure scale invariance, SIFT uses a cascading filtering approach in 3 scales, to detect local maxima and minima.

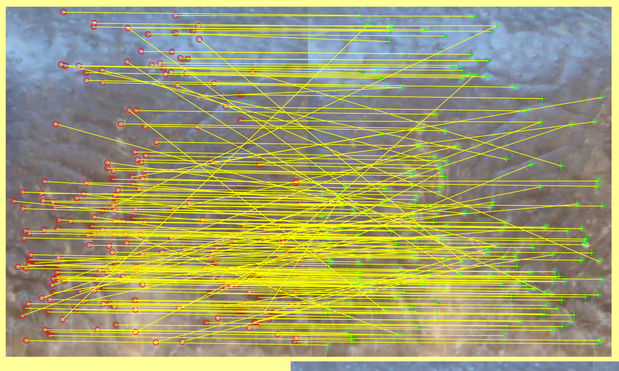


Graph Matching

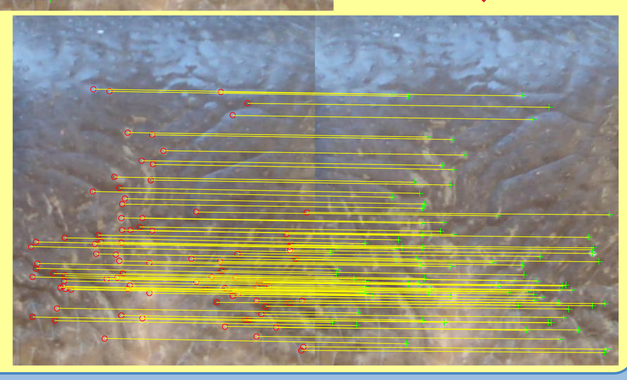
The scores obtained



Matching Refinement



Maximum Likelihood Estimation Sample Consensus (MLESAC)



Experimental Results

Table 1. Matching averaged scores obtained between five animals.

Animal	Cattle 1	Cattle 5	Cattle 9	Cattle 12	Cattle 15
Cattle 1	**0.5116**	0.0376	0.0264	0.0220	0.0187
Cattle 5	0.0227	**0.2817**	0.0143	0.0220	0.0194
Cattle 9	0.0271	0.0190	**0.7292**	0.0197	0.0184
Cattle 12	0.0487	0.0245	0.0325	**0.4832**	0.0256
Cattle 15	0.0152	0.0127	0.0111	0.0101	**0.5412**

The scores obtained between testing and training images of the same animal are always higher than the ones obtained with other animal images, even with image rotation.

Initial matching and after matching refinement