Application of pattern recognition technology in the field scientific bird video

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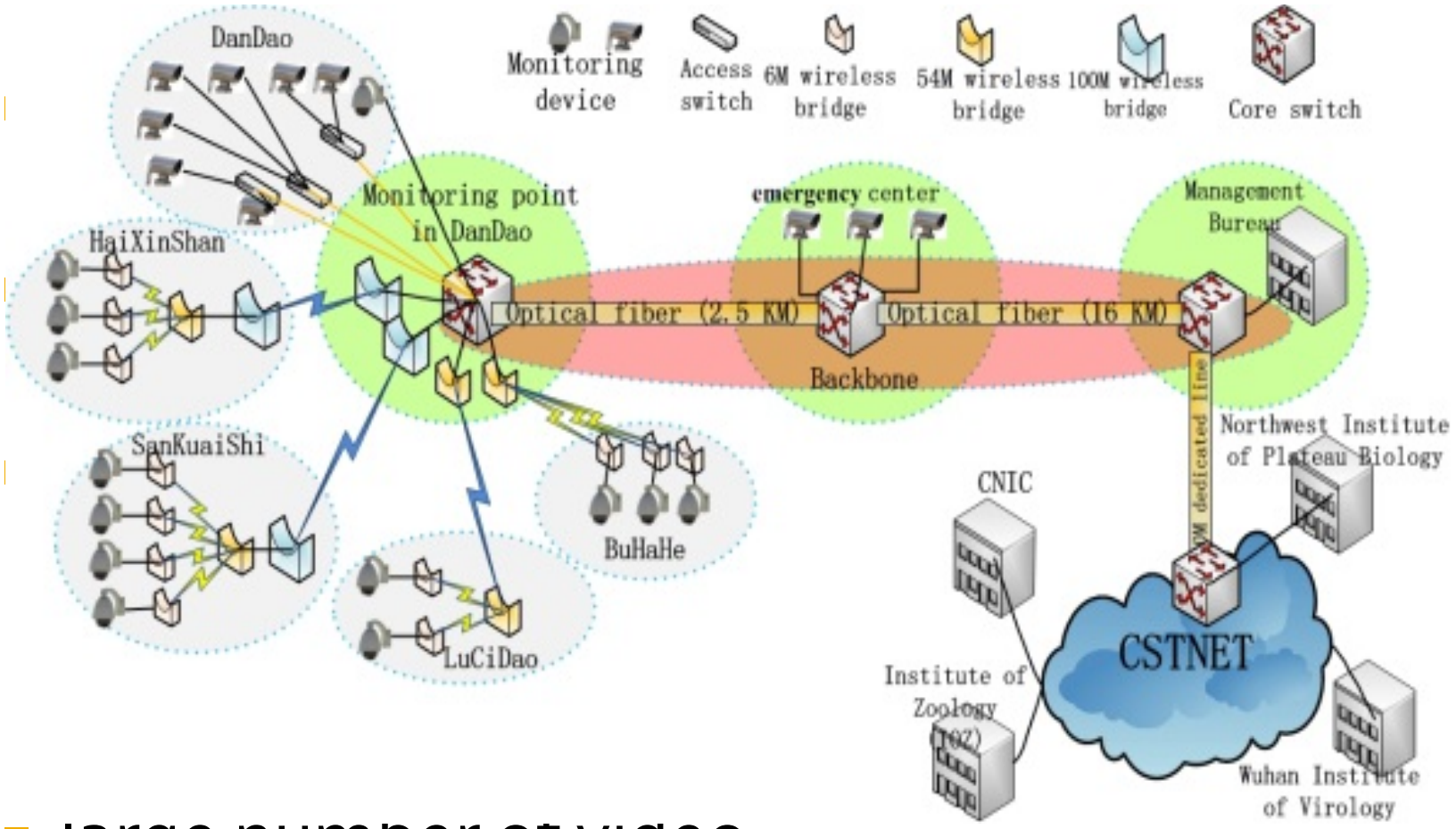
Background



- large number of video

Outline

- **Morphology classification and behaviors identification of birds in scientific video**
  - breeding behavior of bar-headed geese
- **Preliminary classification of birds video in Qinghai Lake**

Morphology classification and behaviors identification

- Research Status
  - Movement and behavior analysis of animals such as mice in the fixed independent scene ;
  - Aiming at action and mutual interaction of different kinds of animals in fixed scene

How to do?

- Target detection and tracking
- Morphology Classify
- Birds Behaviors Identification

Target detection and tracking

- Animal target tracking plays a significant role in subsequent links as animal motion parameters extraction, animal behavior analysis, etc. Through the analysis and comparison of all kinds of algorithms, we choose and improve the camshift algorithm to do animal target tracking.
- In order to realize multi-targets tracking, and solve the problem of target tracking failure, we improve the camshift algorithm. We use binary difference method to update the history information of target motion, with the specified target size threshold and constrained relationship, we can realize multi-targets tracking and when the target tracking failure it will not appear abnormal.

Target detection and tracking

- We implemented the algorithm based on the OpenCV library. We analyzed the video of Qinghai Lake, detection and tracking the bar-headed geese target in the video. Using two modes:

bigger than the threshold value.

Morphology Classify

- we research the animal target posture classification and recognition technology; research the shape feature extraction technology, to extract effective features from the animals, as input parameters of a posture classifier. Research data classification technology; build training and testing samples for classifier.

Morphology Definition

0 Stand

1 Bend

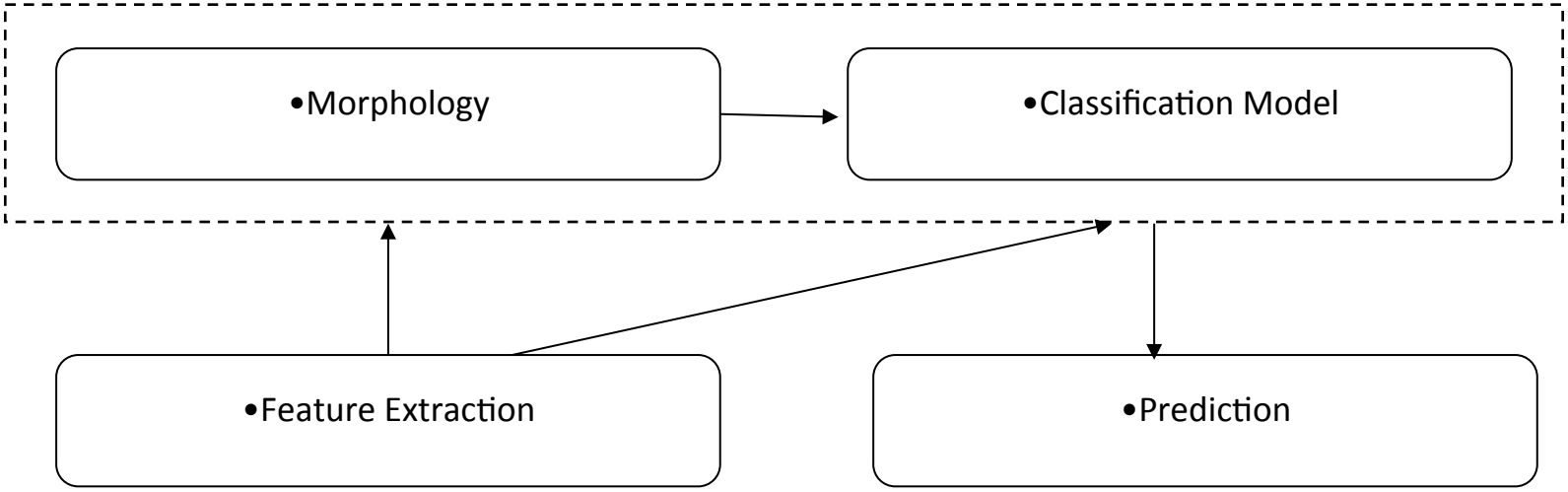
N	Name	Description
0	standing	Upright head, neck and leg
1	bending	Curled neck
2	crouching	Upright head and neck, curled leg
3	winging	Opened wing

2 Crouch

3 Wing

Morphology Classify

- Support Vector Machine (SVM) is an excellent supervised learning method for classification problems. It takes a training set composed of a list of records as its input and builds a model as the output. Each record is a feature vector containing a series of attributes and a hand marking label.



Feature Extraction

- Feature extraction is very important for model building in SVM. Appropriate features can highly promote the computing efficiency and prediction accuracy. In our experiment, we extract 9 features in total. They are area factor F which defines as the number the target's area divide perimeter, aspect ratio R representing the number length divide width, and 7 Hu invariant moments.

Data Sets

- We collect 289 records for training set and 95 records for test set. Their distributions are shown as the table, in which 0,1,2,3 are the indexes of 4 morphologies.

set	total	0	1	2	3
training	289	102	67	45	90
test	95	19	24	27	25

Data Sets

- Each record is a 10-D vector, 9 of which are features, and the 10th is the index label of morphology. The index labels of training records are known before training a model, while in test records, they are unknown waiting for prediction by the model.

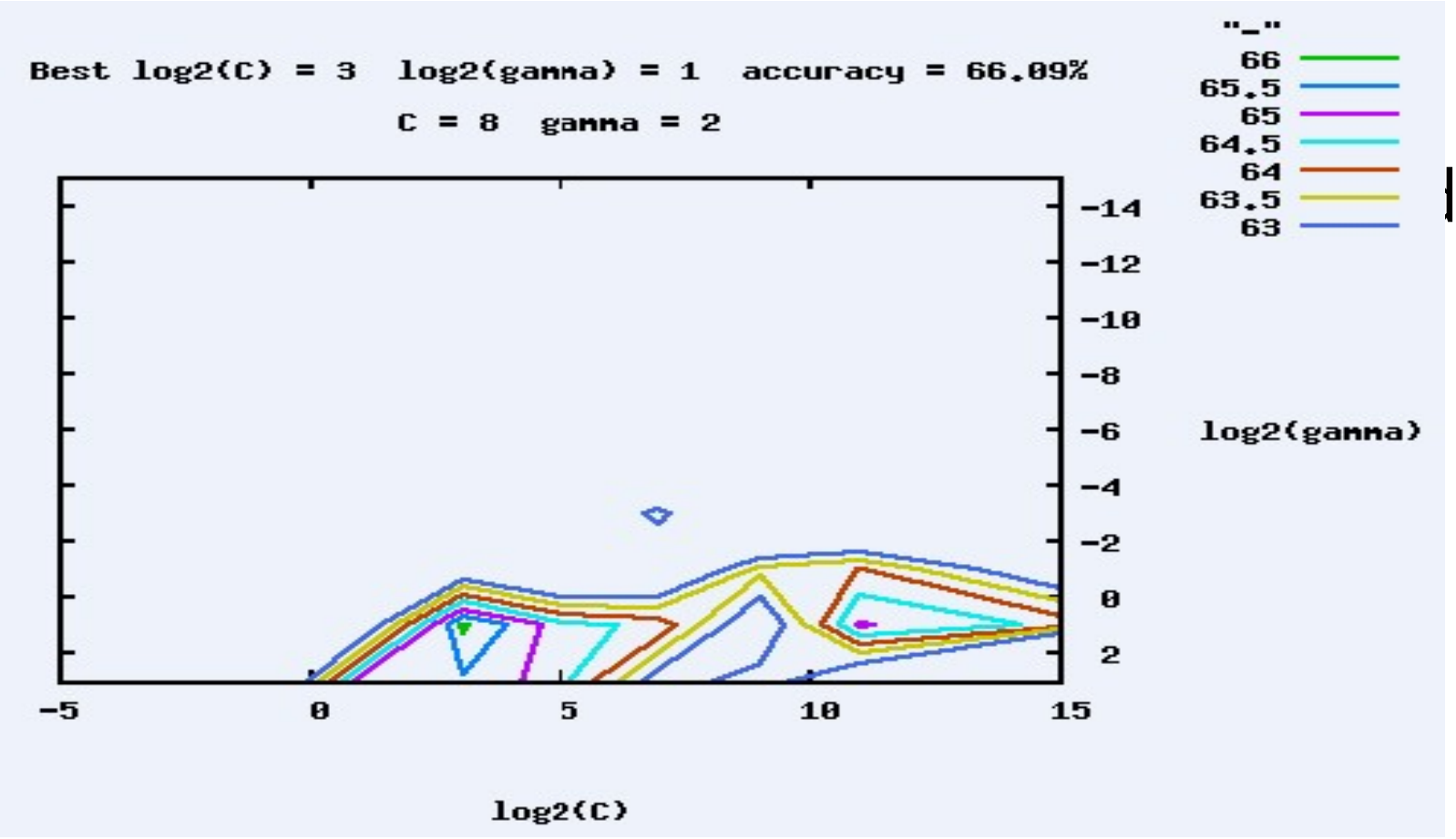
R	F	H1	H2	H3
0.513	44.6	5.45E-08	1.47E-14	2.17E-16
H4	**H5**	**H6**	**H7**	
8.53E-17	1.75E-32	7.42E-24	-1.47E-33	

SVM Training

- Kernel function is the core of SVM algorithm, by which SVM reaches the purpose of classification with little computation. In our experiment, we use RBF kernel function because experiment results indicate that it can reach an ideal classification effect without prior knowledge. RBF kernel function is like:

$$K(x, x_i) = \exp\left(-\frac{|x - x_i|^2}{\sigma^2}\right)$$

SVM Training



Model Evaluation

- In order to verify the performance of the model, we need to use the test set prepared in advance. The prediction result is

No.	sample	result	0	1	2	3
0	19	25	14	4	1	0
1	24	24	1	14	5	4
2	27	25	2	4	19	2
3	25	21	8	2	0	15

Model Evaluation

- According to Table 3.4, there are 95 records whose labels need to be predicted in total, in which 19 are standing, 24 are bending, 27 are crouching, and 25 are winging. While in the result, there are 62 records whose label are predicted correctly which means the accuracy of the model is 65.3%.

Model Evaluation

- In order to evaluate the model's performance of specific morphology, we define two parameters, one is precision σp, and another is recall σr, their definitions are as follows:
- Suppose there are m records of morphology A (A can be one of standing, bending, crouching and winging), and in the prediction result there are n A records, in which p are correct, then σp=p/n, and σr=p/m.

Model Evaluation

- The precision and recall of 4 morphologies

No.	sample	result	correct	precision	recall
0	19	25	14	56%	73.7%
1	24	24	14	58.3%	58.3%
2	27	25	19	76%	70.4%
3	25	21	15	71.4%	60%

Birds Behaviors Identification

Posture	Decision conditions	Basic behavior
Stand	the duration t	standing watch
Stand	continuous change of location	walking
Crouch	the duration t	hatching
Bend	the duration t	hatching
Wing	the duration t	fighting

Birds Behaviors Identification

- Combining with the results of target detection, target tracking, posture classification and decision conditions of basic behaviors. We achieved a recognition system of bar-headed geese behaviors in monitor video. Through the validation using some 2012 monitor video, the recognition rate of 4 basic behaviors can reach about: standing watch 56%; walking 56%; hatching 64.7%; fighting 71.4%. Considering the complexity of the field real-time monitoring and the influence of many other factors, this rate is satisfying.

Next…

- Study the factors, which affect the recognition rate. Improve the basic behavior recognition rate.
- Establish the normal behavior database of birds this year.

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Preliminary classification of birds video in Qinghai Lake

- Massive amounts of scientific video need to pre-processing
- Preliminary classification of birds video
- Improve researchers efficiency in work

Preliminary classification of birds video in Qinghai Lake

- Fast compare speed of image
- Traditional methods base on pixels of image, low efficiency
- Fast method: base on image hashing

Preliminary classification of birds video in Qinghai Lake

- Perceptual hash algorithm
  - Generate fingerprint character string for image
  - Compare strings
  - Close result, Close image

Preliminary classification of birds video in Qinghai Lake

- Concrete Measures
  - Extract one frame every 20 second, 15 frames for one video section
  - Do hashing for 15 frames of image, get 15 hashing strings
  - Compare with checking database, get 4 groups compare results (15*30 for every group)
  - Calculate 4 average compare results, judge the bird species.

Preliminary classification of birds video in Qinghai Lake

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  - Four s Black-necke
  - Cut 3(s, conta ngles
  - Hash as check

Preliminary classification of birds video in Qinghai Lake

- Experiment Result

	CD: Bar-headed Goose	CD: Black-necked Crane	CD: Cormorant	CD: Pallas's Gull
Video 1 (Bar-headed Goose)	9.86	3.47	6.53	7.83
Video 2 (Black-necked Crane)	2.46	13.65	1.24	2.98
Video 3 (Cormorant)	4.35	2.65	12.68	6.78
Video 4 (Pallas's Gull)	7.45	3.35	5.89	11.67

CD=Checking Database

Preliminary classification of birds video in Qinghai Lake

- Analysis
  - Classification for the video of Bar-headed Goose has poorer result:
    - Color of bar-headed goose close to the color of background
    - Crowded together
  - Time efficiency (test on DELL R510)
    - Frames getting & Hashing: 830ms
    - Compare: 1834ms

Preliminary classification of birds video in Qinghai Lake

- Next
  - Improve the accuracy rate
  - Realize one system for preliminary classification of birds video

Thanks!

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