

EVENT CLASSIFICATION FROM PHOTO COLLECTIONS



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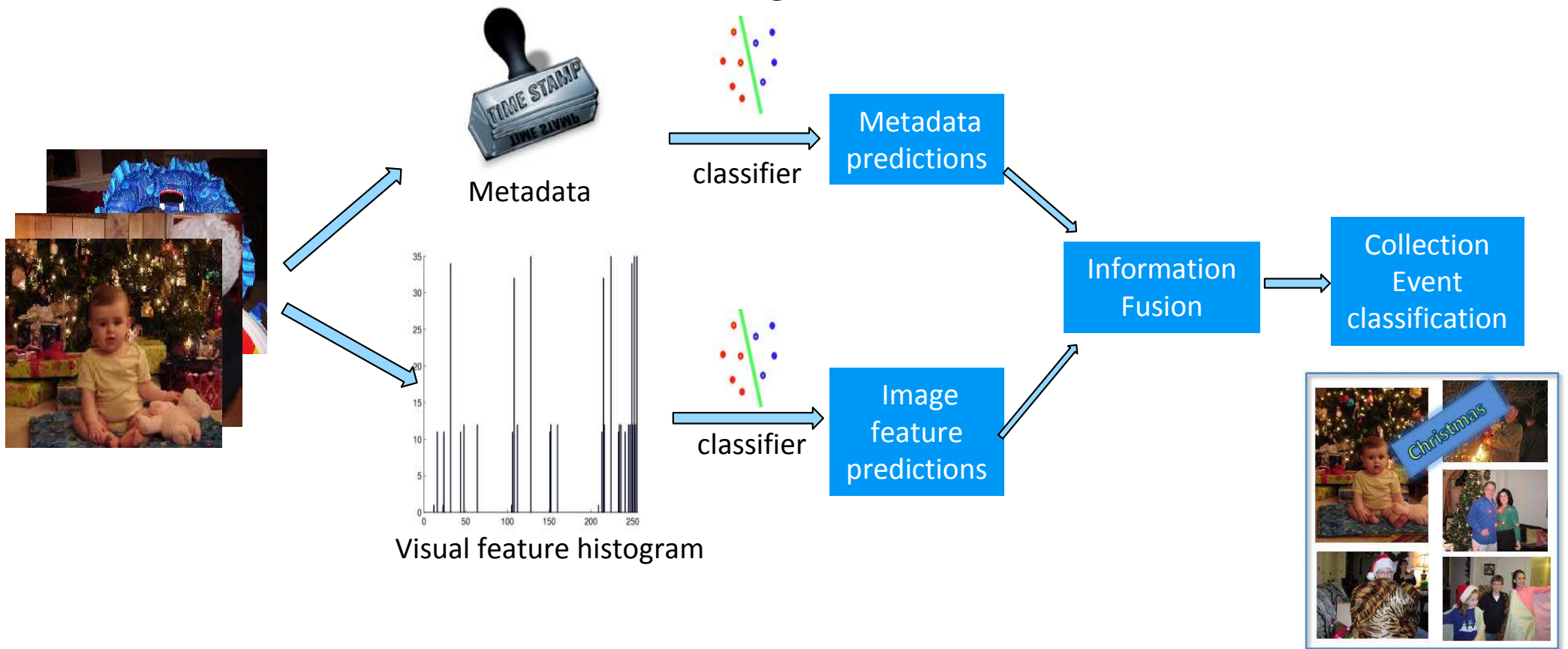
MOTIVATION

- People frequently take pictures to keep the memory of events in their lives and save those photos in the computer or web albums.
- Our goal
 - classify different event categories from a group of photos that contain
- Example events
 - Christmas, Halloween, Valentine's day, Outdoor sports, etc
- Very challenging problem
- Organize and management personal photo collections
- Tell stories of people's life
- Recommend photo products based on the collection theme



SYSTEM OVERVIEW

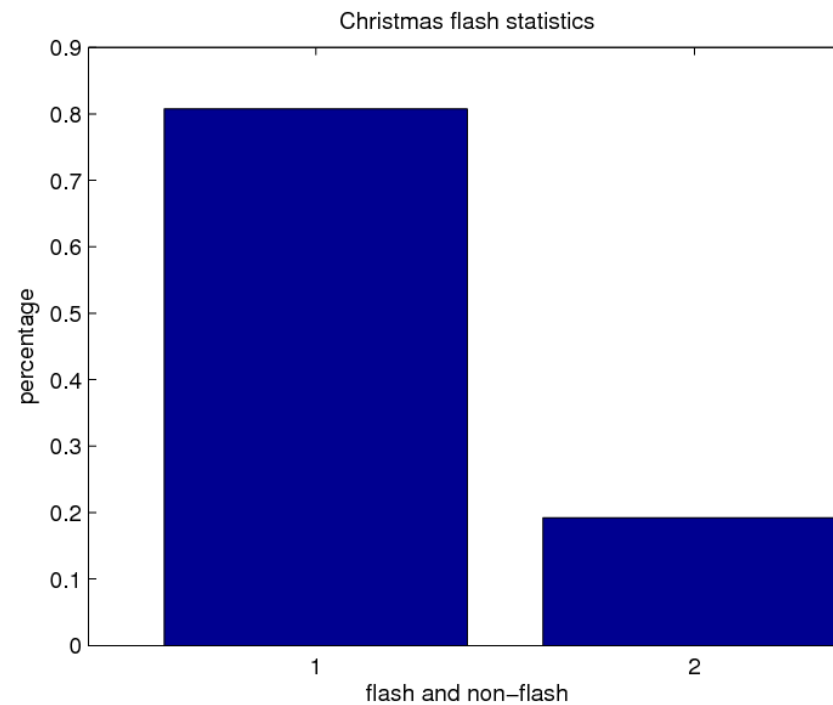
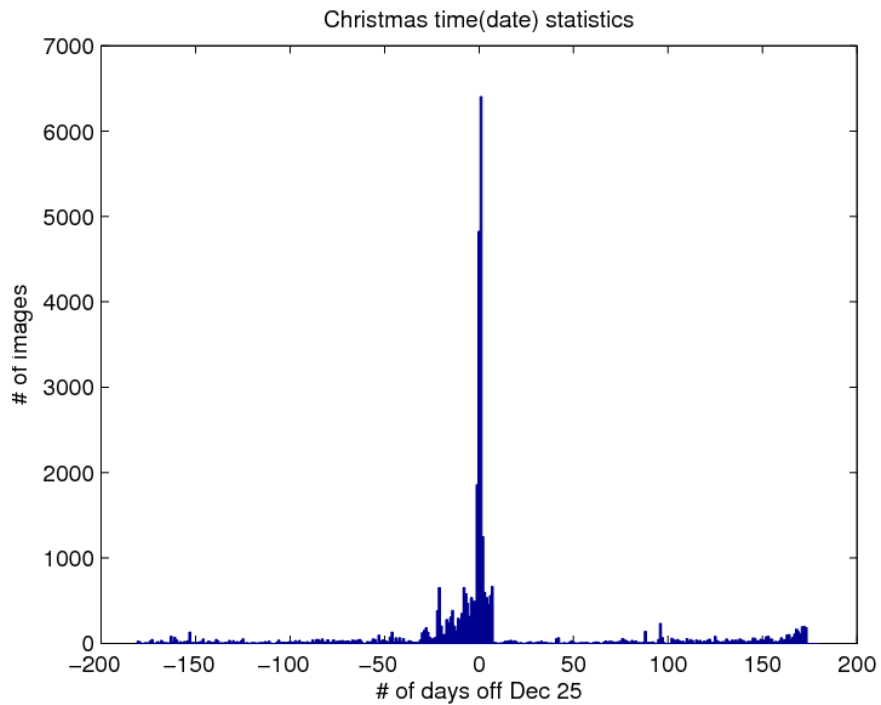
- Combine both metadata and visual information and information from all the images



METADATA

– Metadata

- Timestamps, flash on/off, exposure time, focal length
- They are correlated with events
 - For example, Christmas photos are often captured at night, so most of them has flash on



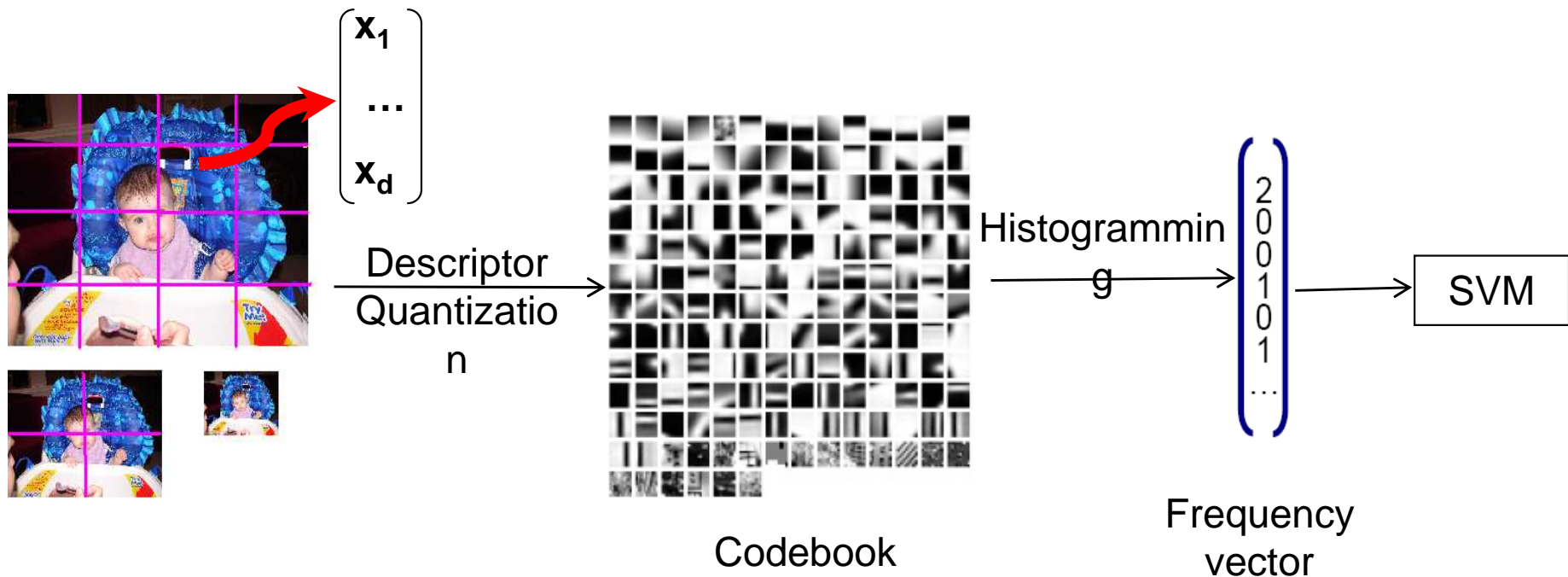
METADATA CLASSIFIER

- Random forest classifier
 - A random forest multi-way classifier consists of an ensemble of trees
- An image is classified by sending the features down every tree and aggregating the reached leaf distributions.
- State-of-the-art performance and very fast to compute



VISUAL ANALYSIS

- Image content provides strong cues to event
 - Bag-of-feature model with SVM
 - Very easy to extend to more categories



COLLECTION

- The event type prediction from a single image may not be reliable
- aggregation of all the predictions in a collection



INFORMATION FUSION

- Single image prediction

$$I_i \quad \text{Image } I \text{ in a collection} \quad I = \{I_1, \dots, I_i, \dots, I_n\}$$

- Probability output for each image

$$P_{i,j}^v \quad \text{Probability of predicting image } i \text{ as event } j \text{ using visual features}$$
$$P_i^v = [P_{i,1}^v, \dots, P_{i,j}^v, \dots, P_{i,k}^v]$$
$$P_{i,j}^m \quad \text{Probability of predicting image } i \text{ as event } j \text{ using metadata}$$
$$P_i^m = [P_{i,1}^m, \dots, P_{i,j}^m, \dots, P_{i,k}^m]$$

- Different feature have different confidence for different events

$$W_j^v \quad \text{Weight/confidence for visual feature to classify event } j$$
$$W^v = [w_1^v, \dots, w_j^v, \dots, w_k^v]$$
$$W_j^m \quad \text{Weight/confidence for metadata to classify event } j$$
$$W^m = [w_1^m, \dots, w_j^m, \dots, w_k^m]$$

INFORMATION FUSION

- Weighted combination of all the features and images in a collection

$$C(I, j) = \begin{cases} \left(\sum_{i=1}^n [\alpha w_j^m p_{i,j}^m + (1 - \alpha) w_j^v p_{i,j}^v] \right) / n & \text{if metadata available} \\ \left(\sum_{i=1}^n w_j^v p_{i,j}^v \right) / n & \text{if metadata not available} \end{cases}$$

EXPERIMENTAL RESULTS

- Data collected from Picassaweb and manually labeled into 8 event types
- Christmas, Halloween, Valentines, 4July, Outdoor, sports, Birthday, Beach, NOA(none of the above)
- More than 100K photos collected
- 8000 photos for training visual and metadata classifier
1000 for each category
- 152 collections for collection level testing with 19 for each category



RESULTS FOR SINGLE PHOTO CLASSIFICATION

– Metadata classifier

Table 1 Image level Metadata classification results

	Christmas	Halloween	Valentines	4July	Outdoor sports	Birthday	Beach	NOA
Christmas	0.9060	0.0100	0	0	0	0.0580	0	0.0260
Halloween	0.0280	0.8500	0.0080	0	0.0600	0.0020	0.0600	0.0460
Valentines	0.0040	0.0440	0.7820	0	0.0120	0.0460	0	0.1120
4July	0.0320	0.0400	0	0.8280	0	0.0800	0	0.0200
Outdoor sports	0	0.0300	0.0320	0	0.1900	0.2640	0.0060	0.4780
Birthday	0.1600	0.0860	0.0640	0.0580	0.2260	0.1660	0	0.2400
Beach	0	0.0300	0.0320	0	0.1900	0.1640	0.1060	0.4780
NOA	0.0120	0.0200	0.0420	0.0060	0.0880	0.1360	0.0060	0.6900

– Visual classifier

Table 2 Image level visual classification results

	Christmas	Halloween	Valentines	4July	Outdoor sports	Birthday	Beach	NOA
Christmas	0.7967	0.0500	0.0267	0.0333	0	0.0333	0	0.0600
Halloween	0.0400	0.7100	0.0500	0.0267	0	0.0533	0.0067	0.1133
Valentines	0.0633	0.0633	0.6333	0.0267	0.0033	0.1133	0.0100	0.0867
4July	0.0300	0.0633	0.0467	0.6700	0.0333	0.0700	0.0133	0.0733
Outdoor sports	0	0	0.0067	0.0233	0.9467	0.0033	0.0100	0.0100
Birthday	0.0233	0.0600	0.0633	0.0467	0	0.7700	0.0067	0.0300
Beach	0.0067	0	0.0233	0.0367	0.0133	0.0333	0.8567	0.0300
NOA	0.1067	0.1167	0.1467	0.1000	0.0133	0.0600	0.0500	0.4067



RESULTS FOR COLLECTION LEVEL CLASSIFICATION

Table 3 Collection level classification results

	Christmas	Halloween	Valentines	4July	Outdoor sports	Birthday	Beach	NOA
Christmas	0.7895	0	0	0	0	0.1053	0	0.1053
Halloween	0	0.7368	0	0	0.0526	0.0526	0	0.1579
Valentines	0	0	0.8421	0	0	0.1053	0	0.0526
4July	0	0	0	0.8947	0	0	0	0.1053
Outdoor sports	0	0	0	0	0.8947	0	0	0.1053
Birthday	0.0526	0.0526	0	0	0	0.7368	0.1053	0.0526
Beach	0	0	0.0233	0.0367	0.0133	0.0333	0.8567	0.1111
NOA	0.0526	0.1053	0.0526	0	0.0526	0.0526	0.0526	0.6316



FUTURE WORK

- Go beyond individual photos, directly extract collection level visual features for classification
- Better fusion of different classifiers
- Incorporate new event categories



QUESTIONS?

