TSUBAME 共同利用　平成 25 年度　学術利用　成果報告書

利用課題名　マルチメディア内容解析に関する研究
英文：A Study on Multimedia Content Analysis

利用課題責任者　佐藤 真一
First name Surname　Shin'ichi Satoh

所属　国立情報学研究所
Affiliation　National Institute of Informatics
URL　http://www.nii.ac.jp

邦文抄録（300 字程度）

本研究では、映像等のマルチメディアコンテンツの主として視覚情報を解析し、その意味内容情報を自動抽出する手法について検討する。特に、映像・画像からの特徴量抽出、学習データを用いた意味内容識別器の学習、並びに評価用データの識別・評価という、一連のマルチメディア意味解析処理の TSUBAME における効率の良い実現を目指す。

英文抄録（100 words 程度）

We study multimedia content analysis, namely, analyzing visual information and delineating semantic content information. Especially, we try to investigate efficient implementation of multimedia semantic content analysis pipeline on TSUBAME, including extraction of features from images and videos, training semantic content classifiers using training data, classification and evaluation using test data. For the fiscal year 2013, we try experiments on feature extraction that require very high memory and computational cost such as Dense-ColorSIFT and Fisher Vector Encoding.

Keywords: **5つ程度**

マルチメディア内容解析、特徴抽出、識別器
Multimedia Content Analysis, Feature Extraction, Classifiers, Dense Color SIFT, Fisher Vector Encoding

1. Background and Purpose

We have developed NII-KAORI-SECODE [1], a general framework for semantic concept detection, and use it to participate several benchmarks such as IMAGE-CLEF [2], PASCAL-VOC and TRECVID [3]. The purpose is to evaluate performance of various visual representations for concept detection-like task. In this framework, first features are extracted from keyframes, then concept detectors using these features are learned by using SVM with -chi-square RBF kernel. The probability output scores of the learned concept detectors are used for ranking.

We evaluate both global features and local features. The global features include color moments, color histogram, edge orientation histogram, and local binary patterns. The local feature is based on the BOW model in which the SIFT descriptor is extracted at interest

points detected by affine invariant and multi-scale dense sampling detectors.For such benchmarks as IMAGE-CLEF, PASCAL-VOC, TRECVID, to achieve high detection performance, it requires to use as many features as possible. Therefore, a huge computational resource is needed.

For example, BBNVISER team (USA) used a shared 309 node, Dual Quad Core, Intel(R) Xeon(R), 32-48GB RAM/node cluster to run for more than 1,000 hours to detect 10 events in 4,000 hours of video.

The purpose of using TSUBAME is to investigate the implementation of the KAORI-SECODE for such large scale experiments. Specically, we are studying how to efficiently handle large I/O requests when processing a large number of images and their associated features; large number of jobs (e.g. training and testing classifiers) needed to run in parallel so that the experiments can be finished in a short time; Furthermore, in this fiscal year 2013, we try experiments requiring very high memory and computational cost such as Dense Color SIFT, Fisher Vector Encoding, Sparse coding and so on.

2. Technical Details

A general framework for building semantic content detectors is shown in Figure 1 (Courtesy of IBM-Columbia Team in TRECVID 2011).

We use VLFEAT library [4] to extract local features such as DSIFT and PHOW using dense sampling at multi-scales. For each image frame, the number of local features is approx. 10,000. The total number of image frames is approx. 1,000,000. These local features are quantized into visual words using 1,000-word codebook. After quantization, soft assignement is used to form a feature vector for each frame. We also use Fisher Vector encoding, Sparse coding for quantization.

We also use color descriptor ColorSIFT with dense sampling at multiple locations and scales. The denser the better performance. However, the computational cost is very high.

We use these features to train and test 100 classifiers for ImageCLEF – Photo Annotation Task, 346 classifiers for TRECVID – Semantic Indexing Task, 20 classifiers for TRECVID – Multimedia Event Detection Task, and Violent Scene Detection. We test with many feature configurations to find which combination achieves the best performance on these benchmarks.

The huge number of features, images, and classifier models require a huge disk space to store and I/O requests to process. When multi-jobs (usually hundreds to thousands of jobs) access the data for I/O at the same time, it causes deadlock at disk storages, network bandwidths.

By using TSUBAME, we would like to study how these problems can be solved.

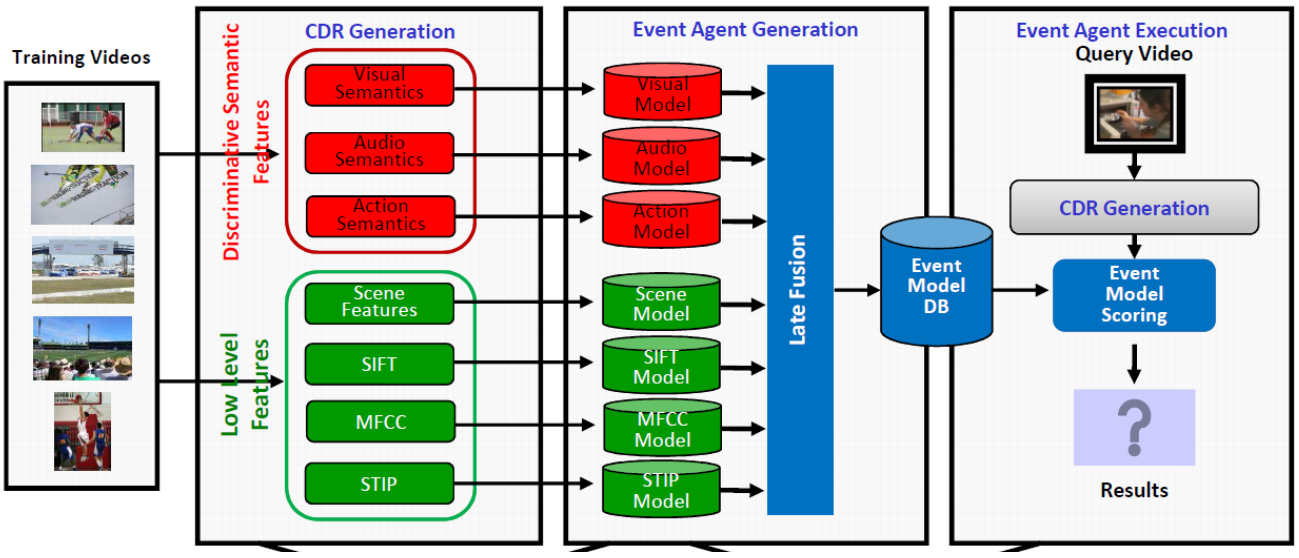
3. Results and Discussions

Due to large number of features, configurations, and time limit, some experiments can not be finished. However, we can confirm that features with denser configurations (i.e. more computational cost) have better performance.

It took about 2 hours to extract one type of feature (SIFT-variations) for 1,000 images. Quantization and soft-assignment take about 3.5 hours. It takes 1 to 4 hours to train a classifier (depending on the number of training samples), and 2 hours for testing the trained classifier to test images.

When it changes to use Dense Color SIFT with 7 scales, the time for feature extraction is 5 times larger than default configurations of 4 scales. To extract features of 1,000 keyframes, it took 2-3 days.

We also observed that new setting requires a lot of local diskspace (30GB) for each job.



Reference

[1] Duy-Dinh Le, Shin'ichi Satoh: A Comprehensive Study of Feature Representations for Semantic Concept Detection. ICSC 2011: 235-238.

[2] Duy-Dinh Le, Shin'ichi Satoh: NII, Japan at ImageCLEF 2011 Photo Annotation Task. CLEF (Notebook Papers/Labs/Workshop) 2011.

[3] Duy-Dinh Le, Sébastien Poullot, Xiaomeng Wu, Bertrand Nouvel, Shin'ichi Satoh: National Institute of Informatics, Japan at TRECVID 2010. TRECVID 2010.

[4] VLFEAT: http://www.vlfeat.org/

Figure 1: A general framework for buiding semantic content detectors (Courtesy of IBM-CU team at TRECVID-MED 2011).