LOGO RECOGNITION USING BUNDLE MIN-HASHING

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INTRODUCTION

The objective is to identify brand logos from given set of images. The dataset consists of various images of objects bearing logos. In order to solve this problem, we tried two approaches:

- Bag of Words.
- Bundle Min-Hashing.

A little bit about the data

Dataset consists of 33 classes. It consists of 32 logo-brands and a no-logo class. For Bag of words, 60% data is used for training and the rest is used for testing. For bundle min-hashing, 10 images from each class is used to create the index for min-hashing and 10 images for testing.

MOTIVATION

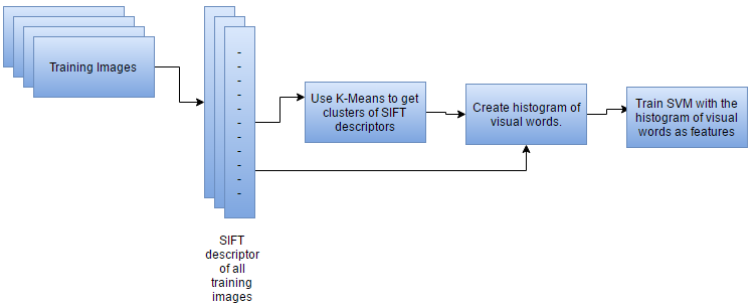
One of the potential application is within marketing industry where, the companies can track down the visibility of their logos within an image or video.

APPROACH

We are primarily using SIFT technique in order to create features for bag of words approach and min-hash for bundle min-hashing approach. The idea is that logos never change. Hence, they should have more or less same descriptors.

BAG OF WORDS

The intuition behind using bag of words approach is that, the visual words are created from SIFT descriptors. Which in turn are scale invariant. Hence, the model can be trained using images of any scale:



1. A vocabulary of visual words was created.
2. Using the bag of visual words, a histogram of visual words was obtained for each training image.
3. SVM was trained using histogram as features.
4. Test image is preprocessed to obtain the histogram of visual words and classified using the model used in step 4.

BUNDLE MIN-HASHING

This is purely information retrieval approach. The idea behind bundle min-hashing is that instead of treating each SIFT descriptor as a single feature, we treat neighborhoods around SIFT descriptors as feature. These neighborhoods form a bundle. This approach preserves the spatial information about the descriptors as opposed to bag of words approach where the spatial information of each descriptor is lost. These bundles simply aggregate the corresponding visual word labels of features.

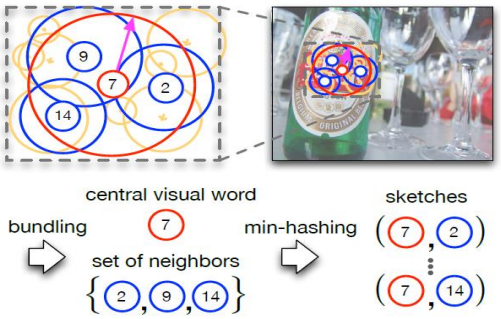
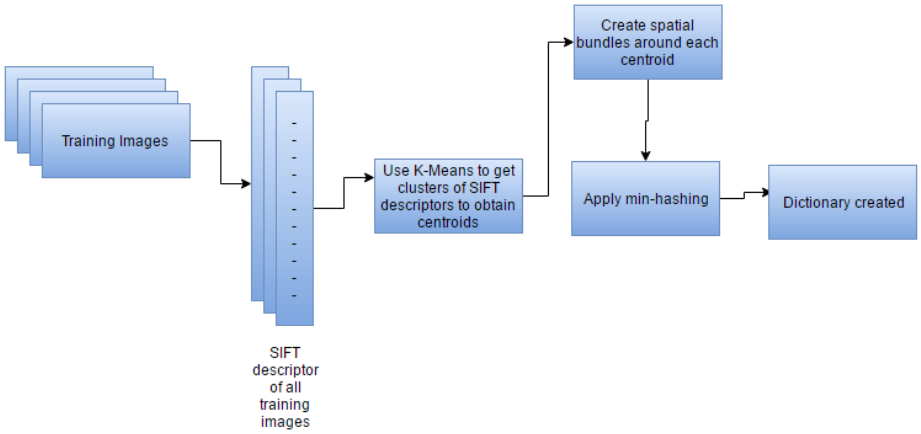


Figure: Min-Hashing. Image courtesy [1]

Min-Hashing is used because it does not have a hard matching requirement and thus can be used for approximate similarity search. Another advantage of this approach over bag of words approach is that, testing time is considerably lower than that of bag of words.



Following are the steps in order to classify logos using bundle min-hashing:

1. For each train image, central features are identified by using k-means, which computes centroids based on the location of the SIFT descriptors.

2. Bundles are formed around these central features. They are created by aggregating the corresponding visual words of the SIFT descriptors in the fixed vicinity (Euclidean distance) of each centroid.
3. Min-hash is created using these bundles. For each image a set of minimum hashes is created and stored in a dictionary. Twenty-five hash functions were used for this purpose. This dictionary is used as an index.
4. Query image is processed to get min-hash using the same bundling approach. The min-hash is then probed against the index to find images with matching min-hashes.
5. Top five images whose min-hash match with that of test image are fetched. These images are the most similar when compared to query image, but all these mages may be of different classes.
6. As a post-verification step, SIFT matching is performed between each image retrieved from the result and the query image.
7. The query image is assigned the label of the image with which it has highest number of matching SIFT descriptors.

RESULTS

Since there are 33 classes, the random guess accuracy is 3.03%.

Bag of Words

Vocabulary Size	Accuracy
100	**12%**
250	**13%**
400	**16%**

Bundle Min-Hashing

Vocabulary Size	No of hash functions	Accuracy
100	**25**	**8%**

Example of Wrong Classification

Actual	Classified as
ALDI 	**Adidas** 

FUTURE WORK

Our results indicate that we can fine tune parameters to obtain better results.

Bag of Words:

For bag of words approach, we tried several vocabulary sizes. As we increased the vocabulary size, we were able to obtain better accuracy. Hence it is safe to claim that, trying with larger vocabulary size can give better accuracy until it starts decreasing.

Bundle Min-Hashing

The hash function which we are using is very basic. A better hash function with optimum vocabulary size and number of hash functions can improve the results significantly. Also, the radius around the centroid

Another improvement can be made by using RANSAC in the post verification step instead of simple SIFT matching.

REFERENCES

- [1] Romberg, Stefan, and Rainer Lienhart. "Bundle min-hashing for logo recognition." *Proceedings of the 3rd ACM conference on International conference on multimedia retrieval*. ACM, 2013
- [2] http://matthewcasperson.blogspot.com/2013/11/minhash-for-dummies.html