Flood detection using Social Media Data and Spectral Regression based Kernel Discriminant Analysis

Muhammad Hanif, Muhammad Atif Tahir, Mahrukh Khan, Mohammad Rafi
School of Computer Science
National University of Computer and Emerging Sciences, Karachi Campus, Pakistan
{k153506,atif.tahir,mahrukh.khan,muhammad.rafi}@nu.edu.pk

ABSTRACT

Natural disasters destroy valuable resources and are necessary to recognize so that appropriate strategies may be designed. In recent past, social networks are very good source to gather event specific information. This working notes paper is based on the task of Disaster Image Retrieval from Social Media dataset (DRISM), as a part of MediaEval, 2017. The Dataset of images and their relevant metadata is taken from various social networks including Twitter and Flicker. An ensemble approach is adopted in this paper where different visual and metadata features are integrated. Kernel Discriminant analysis using spectral regression is then used as dimensionality reduction technique. Mean Average Precision (MAP) at various cutoffs are reported in this paper.

1 INTRODUCTION

The solution is submitted in Multimedia Satellite Task at MediaEval, 2017, on the task "Disaster image retrieval from social media" [1]. The goal of the challenge is to retrieve images, having direct evidence of flood in descending order of probability value for the task.

2 APPROACH

Information is provided in two forms, first includes visual features, while other includes textual metadata of each image. For processing of visual data, features are ensembled to perform classification at the later stage. Figure 1 shows our proposed approach. In this approach, all visual features provided by organizer [1] including AutoColor Correlation, Edge Histogram, Tamura etc are integrated. Kernel Discriminant Analysis using Spectral Regression [2] is then used during classification. Spectral methods have now established as a great technique for both manifold learning and dimensionality reduction and [2]. Spectral Regression in combination with Kernel Discriminant Analysis (SRKDA) has proved successful in many classification tasks such as multilabel classification, action recognition [3, 4]. Large matrix decomposition becomes less complex in this method due to spectral graph analysis. We have also investigated various machine learning techniques such as Random Forest, Support Vector Machine. On validation data and using 10 Fold Cross Validation, the best results were obtained using SRKDA and thus adopted in this task.

In metadata, most valuable features of 'usertags' are selected for prediction. To enhance effectiveness, stop words are removed from selected features. Afterwards, for each image, Term Frequency Inverse Document Frequency (TFIDF) of every user tag is calculated and resultant matrix of TFIDF vectors are saved [5, 6]. The matrix is analyzed with SRKDA to predict the confidence of respective class of each image, as shown in Figure 2.

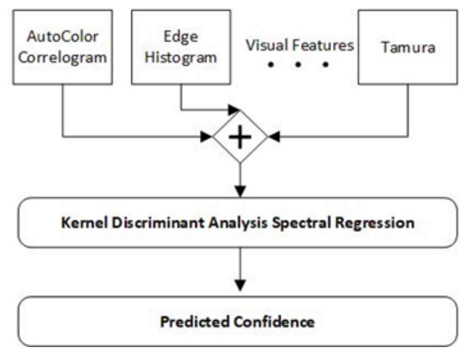

Figure 1: Data Flow diagram for visual feature processing.

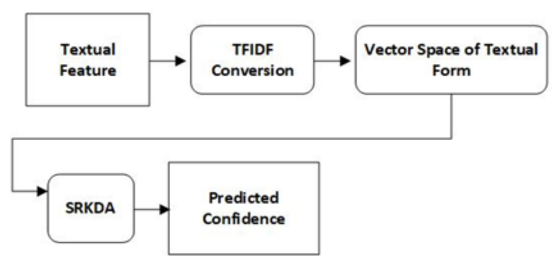

Figure 2: Data Flow diagram for metadata feature processing.

Moreover, a combination of metadata and all visual features are ensembled to produce and processed through SRKDA, as shown in Figure 3.

3 RESULTS AND ANALYSIS

Flood prediction is performed by using datasets of visual features, metadata and combination of both visual features and metadata of each image using SRKDA algorithm.

3.1 Parameter Tunings using Training Data

The most important parameter in our approach is the selection of kernel. Leave one out cross validation is used to select the best kernel in KDA including cityblock, euclidean and chi-squared kernel.

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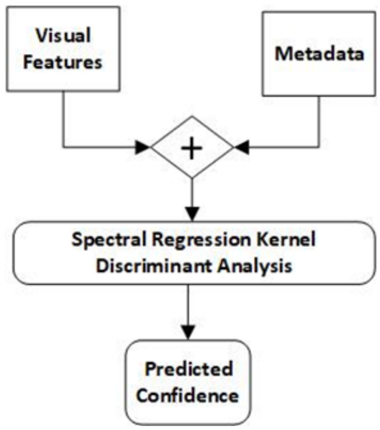

Figure 3: Data flow diagram for fusion of metadata and visual feature processing.

Table 1: Average Precision at various cutoffs using validation data and leave one out cross validation.

AP at various cutoffs	Visual	Meta	Fusion
50	0.9505	0.9617	0.9544
100	0.9517	0.9551	0.9539
200	0.9462	0.9441	0.9492
300	0.9424	0.9385	0.9454
400	0.9386	0.9314	0.942
500	0.9335	0.9252	0.9374

Results of visual features are collected by tuning different parameters of SRKDA and the best results were obtained by using distance as city block and value of Gamma as 0.05 in KDA. Average precision is calculated at different values of k = 50, 100, 200, 300 and 400 and 500 as shown in Figure 4 and Table 1. Average precision were quite high as we able to obtained around 0.94 using fusion of visual and metadata.

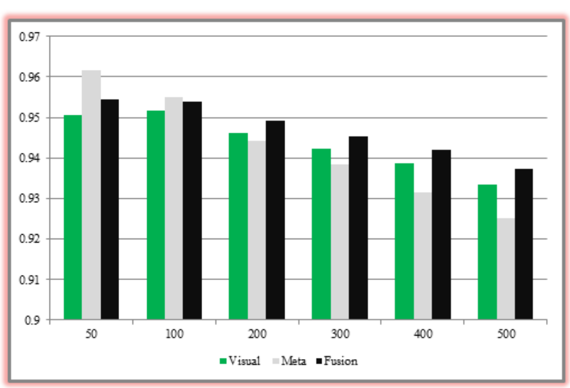

Figure 4: Best results found for visual, metadata and fusion of visual / metadata. Leave one out cross validation is used to select best parameters on training data.

Table 2: Mean over Average Precisions at different cutoffs (50, 100, 250, 480) independently evaluated by organizers.

Run_1	Run_2	Run_3
80.98	71.79	80.84

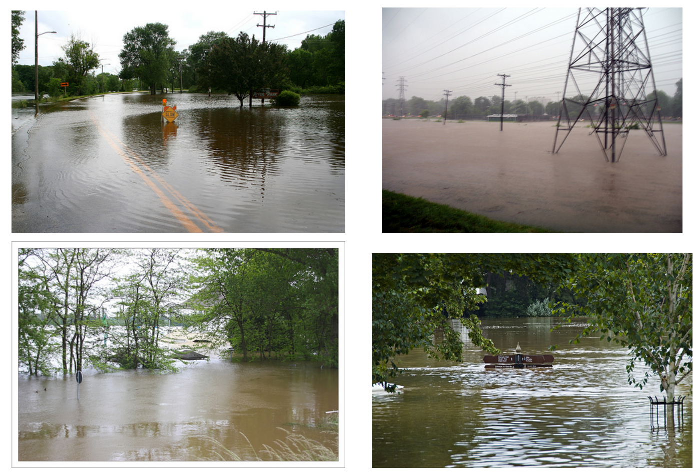

Figure 5: Top 4 images retrieved by the proposed system.

3.2 Results on Test Data

The proposed system is then evaluated on test data and predicted values of all test images are submitted to organizers for independent evaluation. Using visual features, we able to obtain around average precision of 0.649 at 480 cutoff point while for metadata, we able to obtain average precision of around average precision of 0.65. The fusion of visual and meta give us around 0.646 average precision which is surprising as we were expecting better results using fusion. It is part of future work to explore the reasons behind poor performance of fusion. Table 2 shows mean average precisions at different cutoffs. The best results were obtained using visual features which are around 80.98%. Figure 5 shows top 4 images correctly retrieved by the system. Future work aims to identify images that are not correctly retrieved by the system and investigate deep learning approaches to improve the overall system.

The experiments using SRKDA, indicates that fusion of visual and textual features produce better results on validation set. But on test data, the performance drops using fusion of visual and textual features. Particularly for metadata, prediction can be improved by using all provided metadata information including title and description.

4 CONCLUSION

In this paper, we have presented our runs on Disaster Image Retrieval from Social Media task (DRISM). SRKDA technique is investigated to train and test the model using ensemble of 6 different features. Our proposed system able to obtain around 0.81 mean average precisions at different cutoffs (50, 100, 250, 480).

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