SEMI-SUPERVISED FEATURE EMBEDDING FOR DATA SANITIZATION IN REAL-WORLD EVENTS

(ICASSP-2021, Paper ID: 1546)

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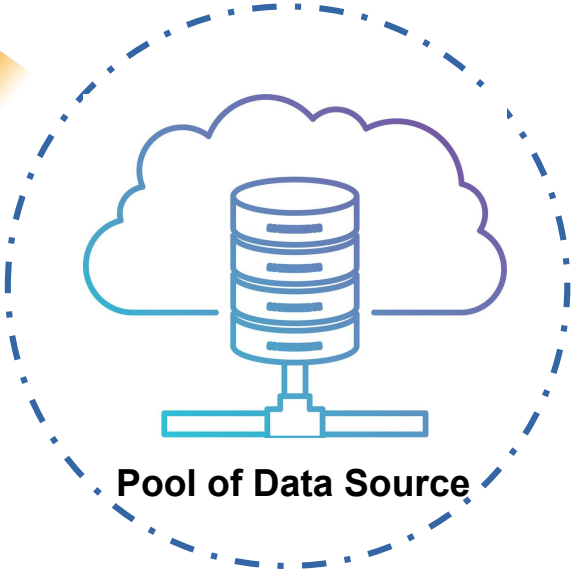
Forensics on Real-World Events

Uncleaned Event (X)

Which are the relevant and irrelevant samples to the event (X)?



Pool of Data Source

What is Image Data Sanitization?

- **The goal is determining of the relevant samples from irrelevant ones upon an event of interest.**

Irrelevant examples to the event

Relevant examples to the event

Image examples are taken from Notre Dame Cathedral Fire Dataset.

Collected Datasets

"Big"-data events

Small-data events

Event	Location	Year	Number of images			Source
			Positive	*Negative*	*Unlabeled*	
Notre-Dame Cathedral	Paris, France	2019	1660	22023	0	Twitter (93.2% of the images) Flickr (6.8% of the images)
Grenfell Tower	London, UK	2017	14161	0	0	Forensic Architecture team
Marathon Bombing	Boston, US	2013	19092	0	0	YouTube video frames
Bangladesh Fire	Dhaka, BD	2019	125	125	709	Twitter (96.0% of the images) Flickr (4.0% of the images)
National Museum	Rio de Janeiro, Brazil	2018	125	125	440	Twitter (82.5% of the images) Flickr (16.7% of the images) GooglePlus (0.8% of the images)

Instances of Events

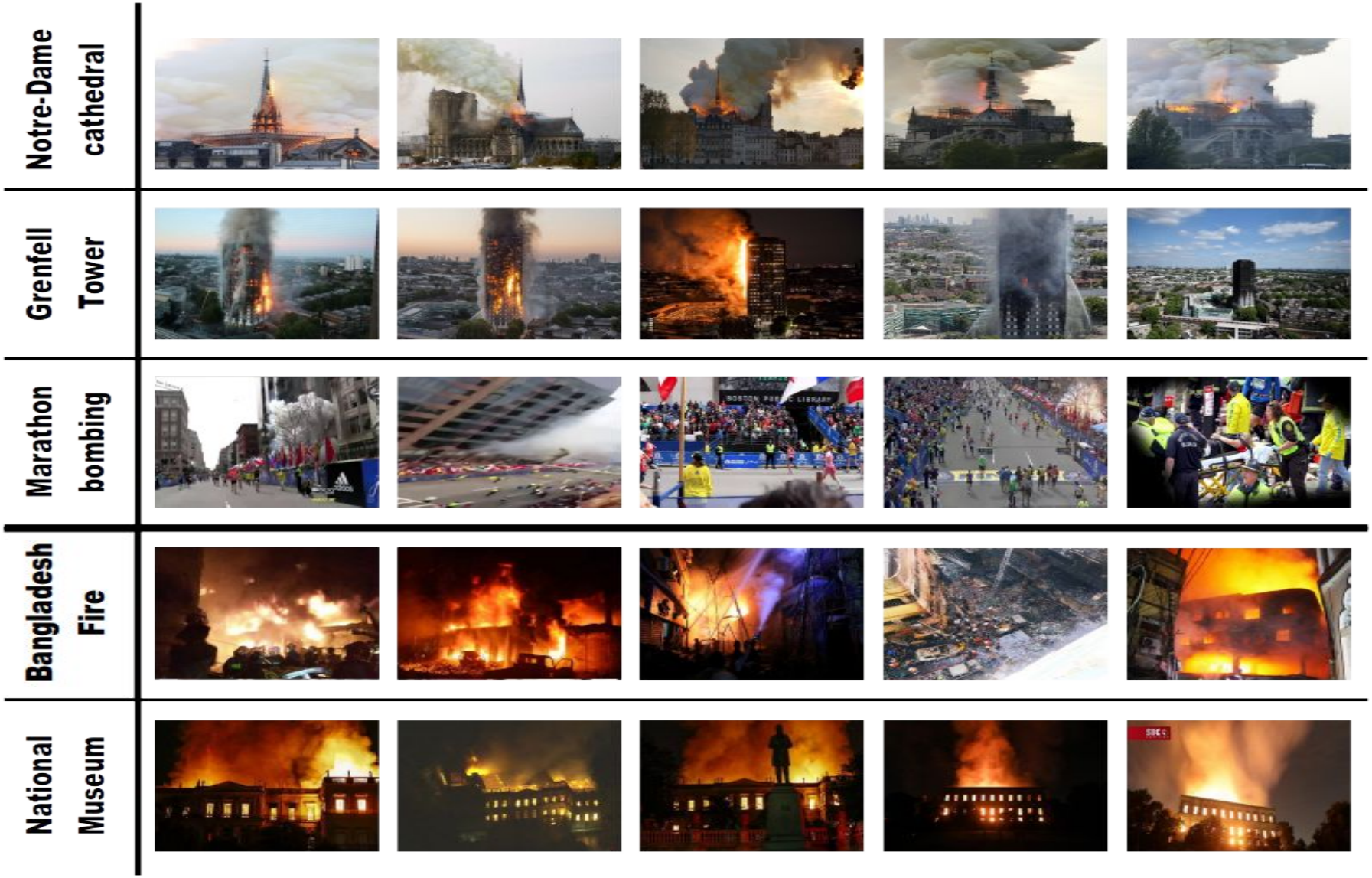


Image Characterstics

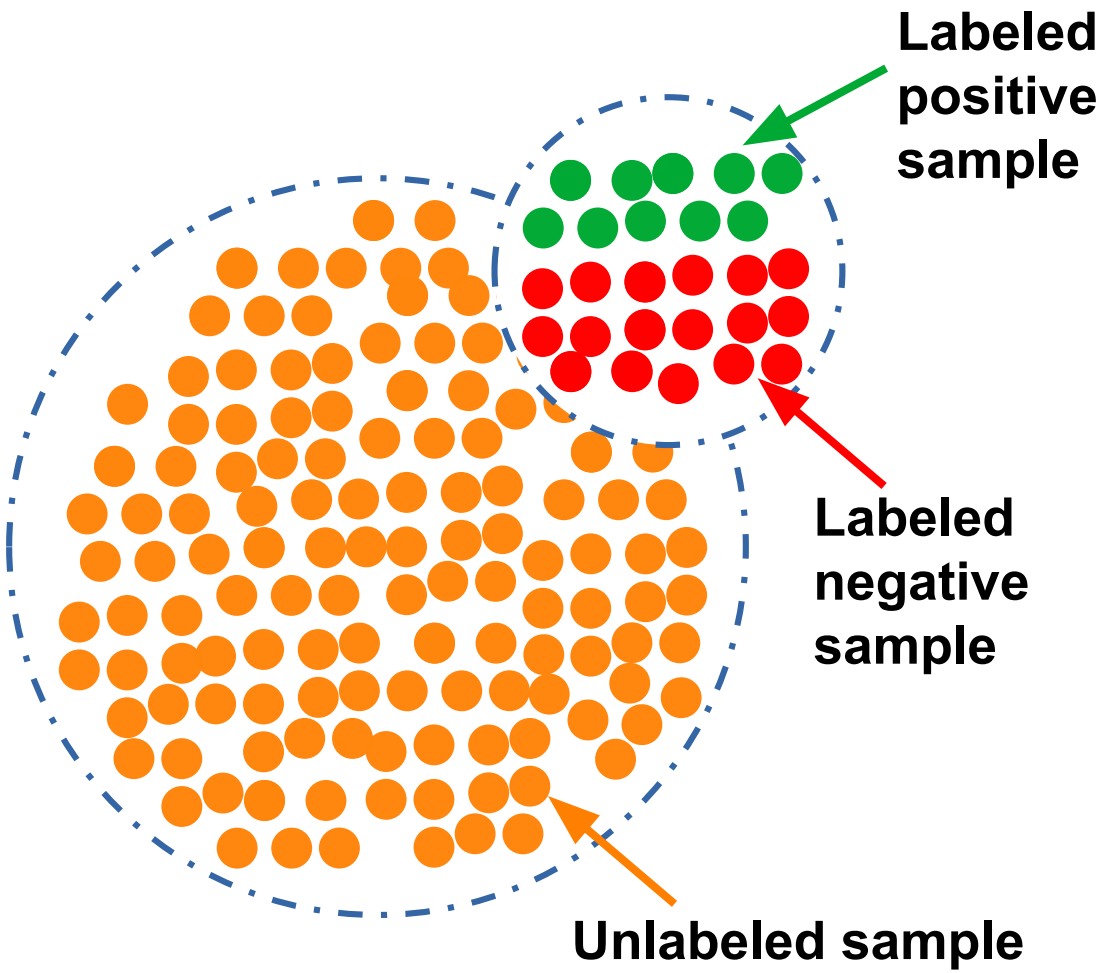
- Data-Driven Features
  - VGG16
  - InceptionV4
  - Xception
- Complementary Features
  - Gabor filters and Covariance (GBICOV) based descriptor
  - Histogram Oriented Gradiant (HOG)

Descriptor	Feature Dimensionality	Image input size
VGG16	4096	224×224
InceptionV4	1536	299×299
Xception	2048	299×299
gBiCov	1536	150×150
HOG	648	150×150

Embedding Learning method

- **Local and Global Consistency (LGC) Semi-Supervised techniq.**

[D. Zhou et al."Learning with local and global consistency" in "Advances in Neural Information Processing Systems".]



$$x_i \in X$$

$$\downarrow$$

$$f : f \rightarrow R^2$$

$$\downarrow$$

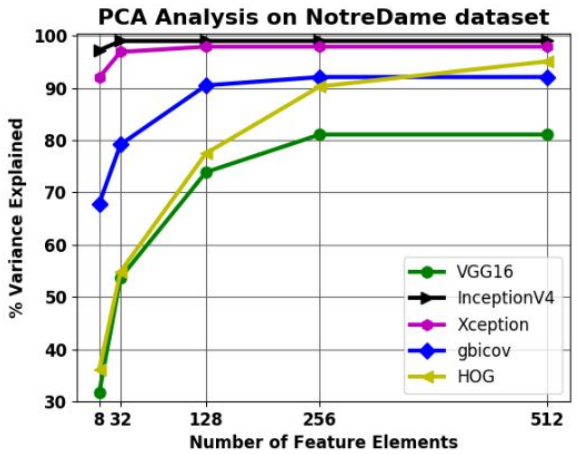
$$f = [f_1, \ldots, f_n]^T.y$$

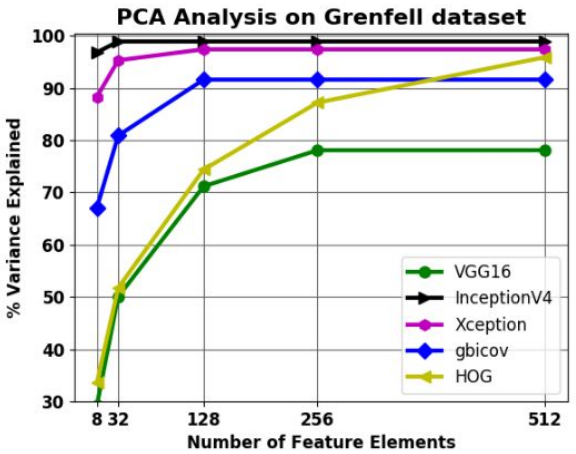
$$\downarrow$$

$$f^* = \underset{j}{\text{argmax}}\, f$$

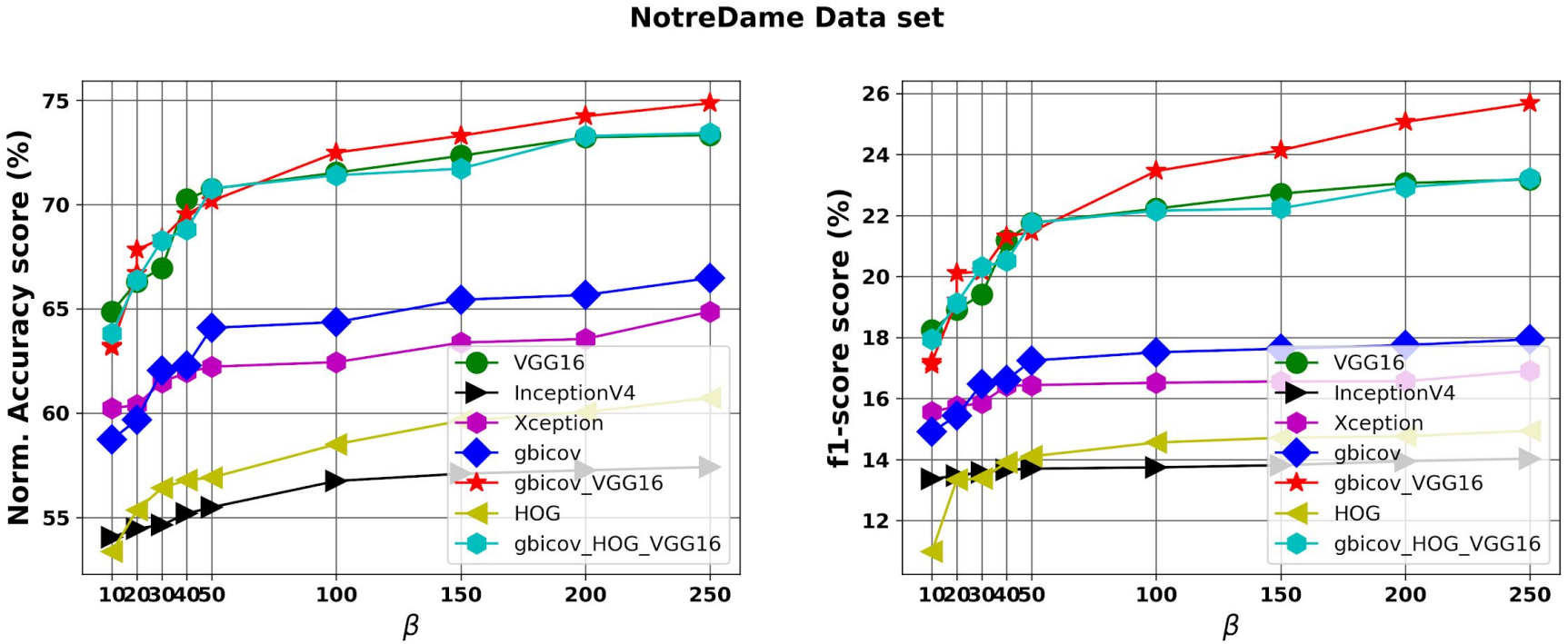
Experimental Setup

- We selected β randomly labeled data samples for each target dataset.
- We adopted kNN to construct our affinity matrix with k=16.
- The LGC algorithm was iterated up to 300.
- We applied PCA to reduce the dimension of each feature to 128 elements.

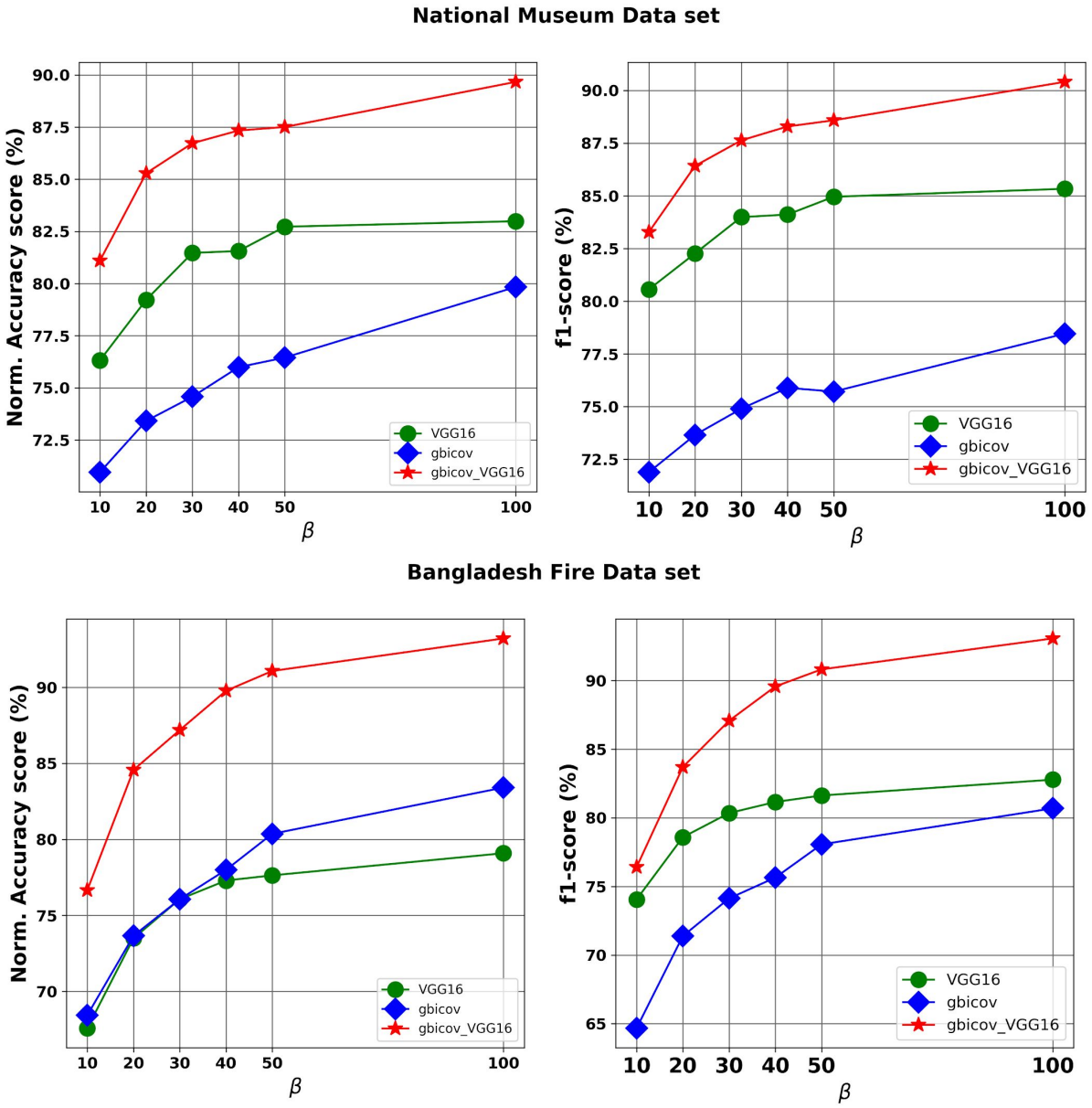




Some Results



Some Results (Cont.)



Conclusions

- Training a supervised learning method for image sanitization is daunting…
- Label spreading has shown to be adequate to this problem properly propagating the labels in five events.
- The best performance accuracy in a range between 65% and 95%
- Exploring semi-supervised algorithms hold promise for the applications that are highly expensive on annotating data process

Future Work

- we are currently exploring a different set of *graph-based semi-supervised techniques* that fit with complex data structure.

- Also we explore *self-supervised learning algorithms* to generate robust feature representation upon the particular structure of an event.

Acknowledgement

This research was supported by São Paulo Research Foundation (FAPESP), under the thematic project "DéjàVu: Feature-Space-Time Coherence from Heterogeneous Data for Media Integrity Analytics and Interpretation of Events" with grant numbers 18/05668-3 and 20/02241-9.