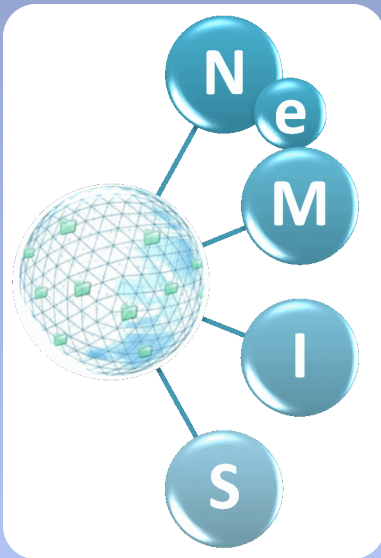


Artificial Intelligence, Image Analysis and Retrieval for the Creative Industry



Giuseppe Amato

giuseppe.amato@isti.cnr.it

NeMIS-MIR

ISTI-CNR

Overview of the keynote

- Managing and searching large scale MM repositories
- Social Media Analysis
- Image recognition and Mobile Interaction on a large scale
- Applications of Face recognition techniques



Overview of the keynote

- Managing and searching large scale MM repositories
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Searching for MM documents

- Production of a program, a reportage, news, etc. generally combines
 - the use of newly created material
 - reuse of existing material contained in digital archives
 - reuse of existing material on the web and social networks



Newly prod. digital cont.



Digital content Archives



Dig. cont on social media

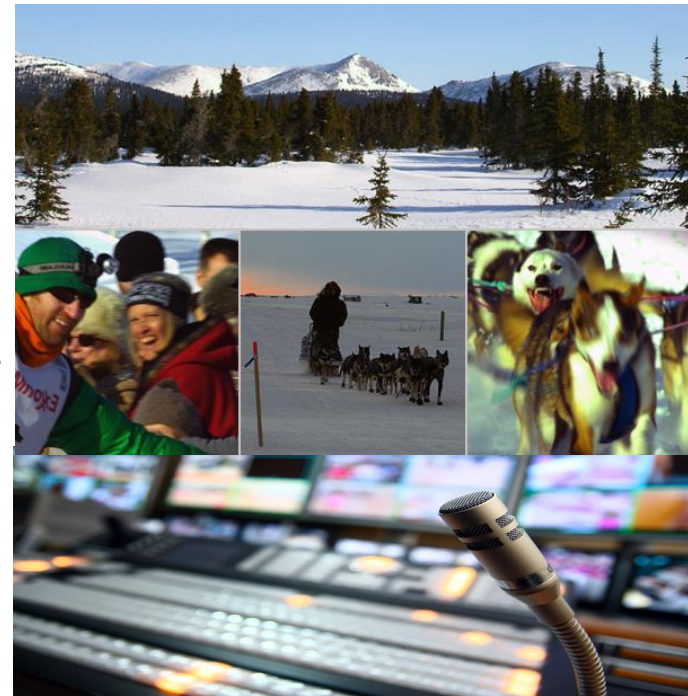


Image search on a very large scale

- A picture is worth 1000 words!



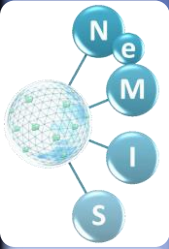
- 1B pictures without words are worth nothing!



- An image contains all relevant information concerning its content

- Very difficult to index and search on a very large scale:

- «search for pictures taken in autumn, with trees with green and yellow leaves, with a trail among leaves»



Large scale Image search: leveraging on Annotation

Automatic or manual annotation:



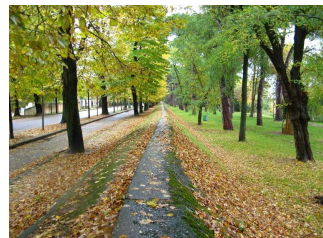
Hands
Screwdriver
Outlet
Wires ...



Hotel des Invalides
Paris
Museum
Grass
Sky ...

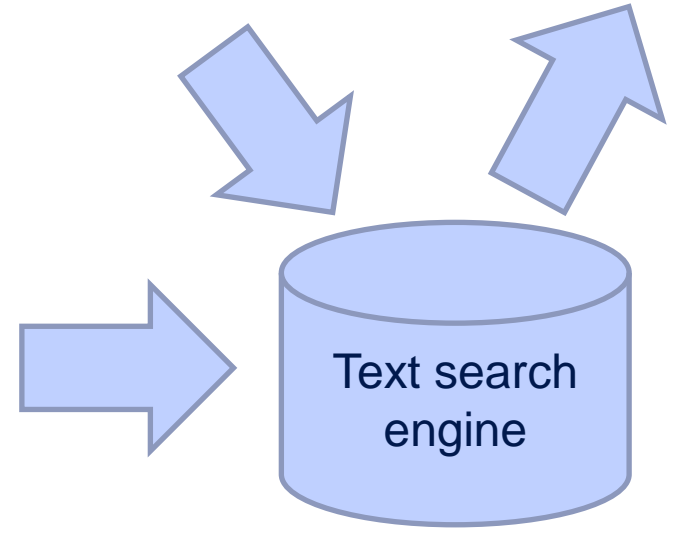
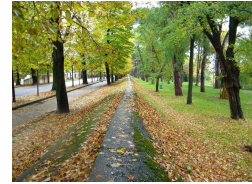


Football
Grass
Score
Player
Goalkeeper ...



Trees
Leaves
Autumn
Trail ...

Text queries:
«trees and leaves»



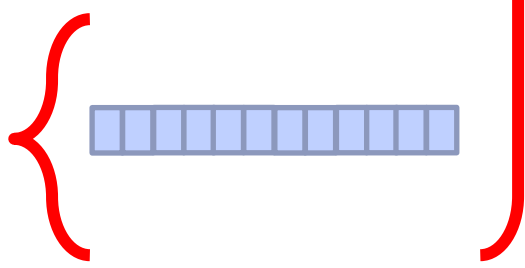
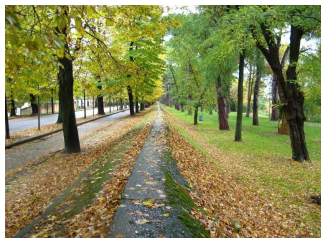
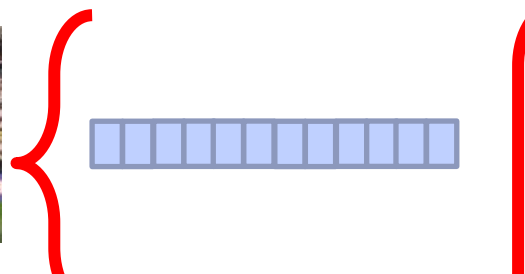
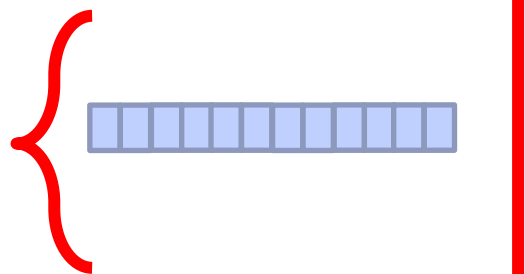
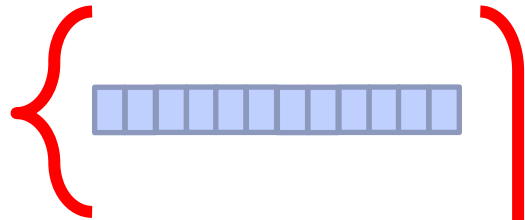
Large scale Image search Issues

- Automatic annotation helps, but does not solve all problems
 - It is possible to use text search techniques to retrieve images
 - However, it is difficult to annotate very large datasets
 - Need to re-index everything when new classes/terms are needed
 - Need to re-index everything if a classifier/annotator is improved



Large scale Image search: leveraging on CBIR

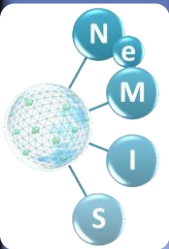
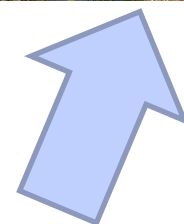
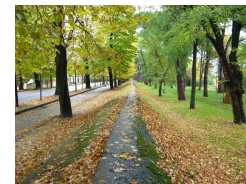
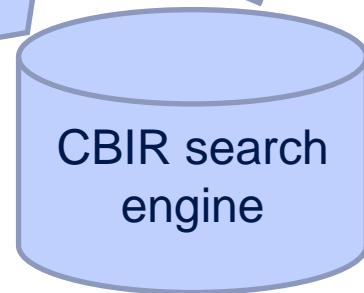
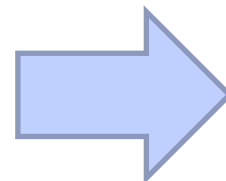
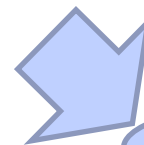
Visual feature extraction:



Query by example



Visual feature

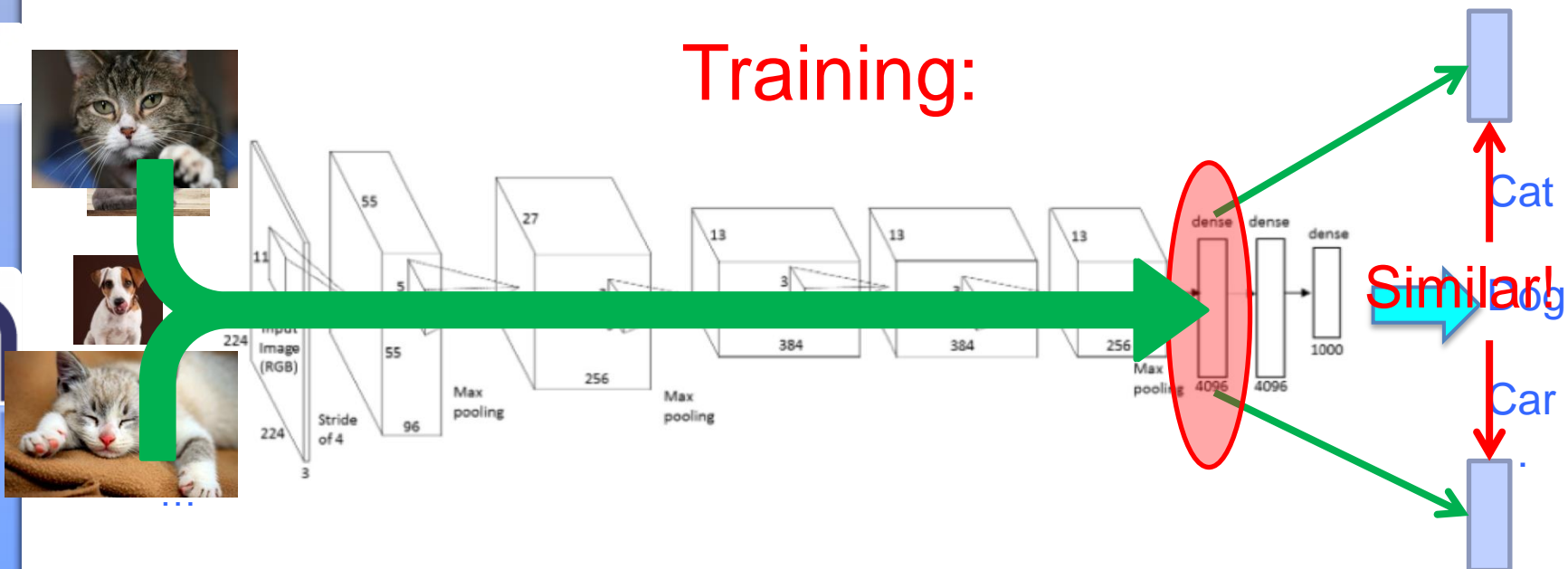


Deep Features

- Activation in intermediate layers of deep CNN can be used as visual descriptors
- If two images are semantically similar the activations are similar as well
 - Transferability of learning property

Intermediate layer activations:

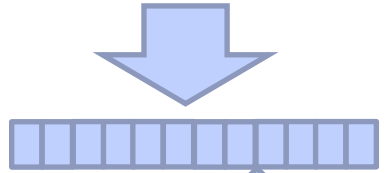
Training:



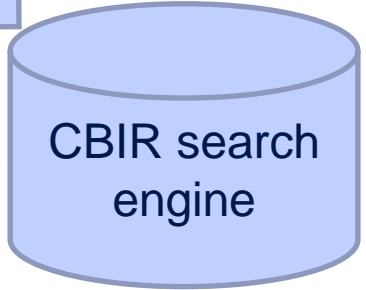
Scalable image similarity searching



A (somehow produced)
visual feature
as a query



Very large database!!!



Very fast similarity
search!!!

Fast similarity search solutions

- Various options
 - **Precomputed distances:** AESA, LAESA, ...
 - **Tree based:** M-Tree, R-Tree, k-d-Tree, k-Means Tree, FLANN, VP-Tree, GNAT, ...
 - **Hashing:** D-Index, LSH, Spectral Hashing,
 - **Quantization:** BoF, Vector quantization, Product Quantization, Polysemous codes, ...
 - **Hybrid:** Permutations, PP-Index, M-Index, MI-File, ...
 -
- No time to discuss them !!!



Content-Based Image Retrieval



0.000000



0.121338



0.140869



0.149658



0.153320



0.158936



0.160400



0.162354



0.163818



0.164063



0.164307



0.165039



0.165283



0.165527



0.165527



0.165771



0.167236



0.167725



0.167725



0.167969



0.168213



0.168213



0.168213



0.168457



Content-Based Image Retrieval



0.000000



0.091064



0.093994



0.096680



0.101318



0.101318



0.105469



0.105713



0.105713



0.107178



0.107422



0.107666



Content-Based Image Retrieval



0.000000



0.168457



0.170166



0.185547



0.186279



0.187012



0



0.193359



0.194580



0.194824



0.195801



0.196045



0.196289



0



0

Image Annotation

Query:



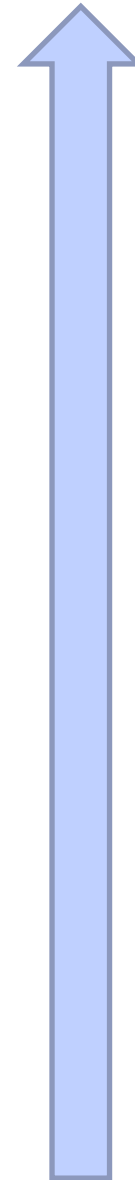
Best guessed tags:

Relevance: 4.83, Guessed tags: amsterdam

Relevance: 4.06, Guessed tags: bike



Very large image datasets



100M
pictures
=
10 Km!!!



Image searching and annotating

DeepFeature
similarity search:
<http://mifile.deepfeatures.org>



Image
annotation



Image
search



Deep Learning for visual search

mifile.deepfeatures.org/?query=777878427

Image Search and Annotation on a Very Large Scale

Using [Deep Features](#) and [MI-File](#) to search and annotate [YFCC100M](#) (Yahoo Flickr Creative Commons 100M) dataset.

MIR Research group

(97 millions images currently indexed)


Upload an image as query: Nessun file selezionato

Choose an url as query:

Choose a random query.

Found 835435 images similar to your query in 1109 ms (Index access Time: 47 ms, Temporary result management time: 844 ms, Database access time: 218 ms)

Query:



Best guessed tags:
Relevance: 21.45, Guessed tags: baseball
Relevance: 6.60, Guessed tags: game
Relevance: 5.83, Guessed tags: pitch

Search using images similar to your query or [see more random images:](#)
















 (Weight 0) Flickr->	 (Weight 407) Flickr->	 (Weight 420) Flickr->	 (Weight 437) Flickr->	 (Weight 438) Flickr->
 (Weight 454) Flickr->	 (Weight 466) Flickr->	 (Weight 466) Flickr->	 (Weight 484) Flickr->	 (Weight 495) Flickr->
				

Image search in digital libraries

The screenshot shows a web browser window with the URL `pair.visualengines.com/melampoUI/Search?id=SCC-A-000007-0001&features=BOF&src=res&similar=true`. The search interface includes a search bar with a "Search" button and several filter options: objects, global color, color structure, color layout, edges, and texture. The search results are displayed in a grid of 15 items, each consisting of a thumbnail image, a "similar" link, a "combo search" link, and a red progress indicator. The images are variations of the Pisa Cathedral, including different views and architectural details. The search time is indicated as 301 ms.

Image ID	Image Description
SCC-A-000007-0001	Original image of Pisa Cathedral
SCC-F-000175-0000	Similar image of Pisa Cathedral
SCC-F-000179-0000	Similar image of Pisa Cathedral
SCC-A-000002-0002	Similar image of Pisa Cathedral
SCC-F-000177-0000	Similar image of Pisa Cathedral
SCC-A-000003-0002	Similar image of Pisa Cathedral
SCC-F-001159-0000	Similar image of Pisa Cathedral
SCC-F-000007-0000	Similar image of Pisa Cathedral
SCC-F-001160-0000	Similar image of Pisa Cathedral
FVQ-F-210239-0000	Similar image of Pisa Cathedral
SCC-F-000435-0000	Similar image of Pisa Cathedral
SCC-F-001164-0000	Similar image of Pisa Cathedral
SCC-F-001163-0000	Similar image of Pisa Cathedral
AVQ-A-002526-0008	Similar image of Pisa Cathedral
FVQ-F-146651-0000	Similar image of Pisa Cathedral

<http://pair.visualengines.com/melampoUI/>




Painting search

<http://art.isti.cnr.it/>







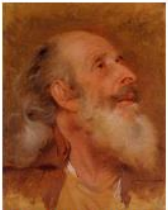











Deep Image Search

art.isti.cnr.it/Search?id=mary-cassatt/woman-with-a-pearl-necklace-1879

App Bookmarks melampo bookmarkle M-File bookmarklet Microsoft Outlook Web La Repubblica.it - Hor Network Camera UBI Banca - QuiUBI

 [Paste image URL](#) Upload an image
Scegli file Nessun file selezionato

search time: 188 ms

 <p>Woman With A Pearl Necklace 1879 Mary Cassatt</p>	 <p>A Seating Bather 1906 Pierre Auguste Renoir</p>	 <p>The Magdalen With Pearls In Her Hair 1919 Lovis Corinth</p>	 <p>Dedee In Spanish Dress 1917 Pierre Auguste Renoir</p>	 <p>Nude Study Christoffer Wilhelm Eckersberg</p>	 <p>Woman Sleeping Pierre Auguste Renoir</p>
 <p>Study Of John Staveley S Head Joseph Wright</p>	 <p>Woman Wearing A Rose Andree 1919 Pierre Auguste Renoir</p>	 <p>Young Girl With Daisies 1889 Pierre Auguste Renoir</p>	 <p>Margit 1891 Anders Zorn</p>	 <p>Seated Bather 1912 Pierre Auguste Renoir</p>	 <p>Sleeping Woman 1897 Pierre Auguste Renoir</p>
 <p>Reclining Nude 1860</p>	 <p>Nude Bather</p>	 <p>Portrait of a woman</p>	 <p>Nude Bather</p>	 <p>Nude Bather</p>	 <p>Reclining Nude 1860</p>



Food recognition

<http://food.isti.cnr.it/>



Deep Image Search x

food.isti.cnr.it/Search?id=hamburger/992429

App Bookmarks melampo bookmarkle M-File bookmarklet Microsoft Outlook We La Repubblica.it - Hor Network Camera UBI Banca - QuiUBI

[Paste image URL](#) Upload an image
Scegli file Nessun file selezionato

Gussed Foods: hamburger search time: 796 ms

Visually Similar

hamburger	hamburger	hamburger	hamburger	hamburger	hamburger	hamburger
hamburger	hamburger	hamburger	foie_gras	pulled_pork_sandwich	hamburger	hamburger
hamburger	pulled_pork_sandwich	hamburger	hamburger	hamburger	pulled_pork_sandwich	ramen

Automatic cleaning of a poorly annotated 100M image dataset :

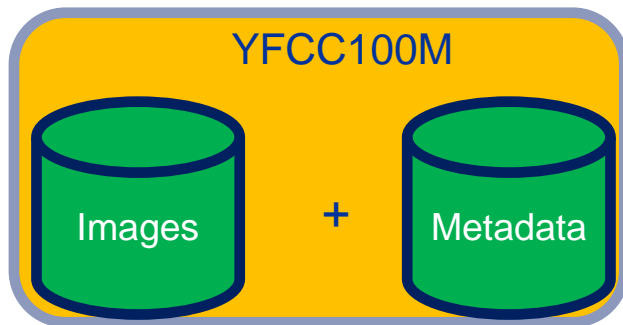
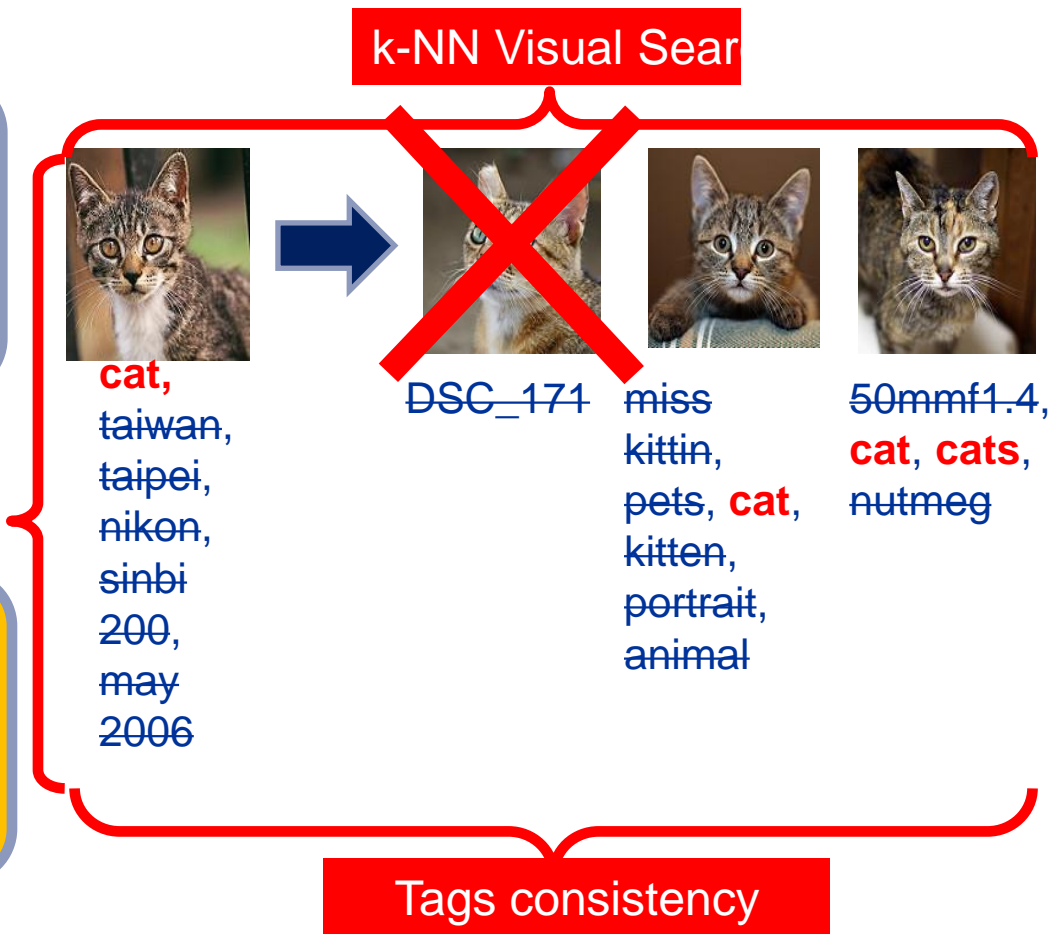
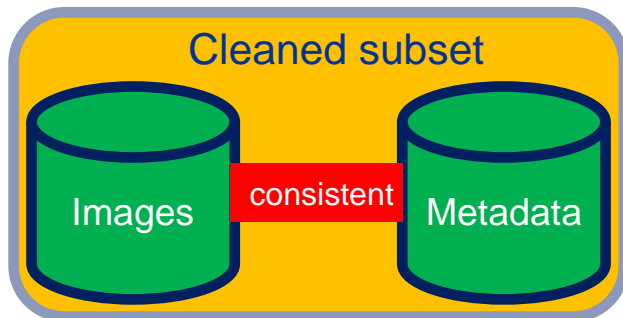
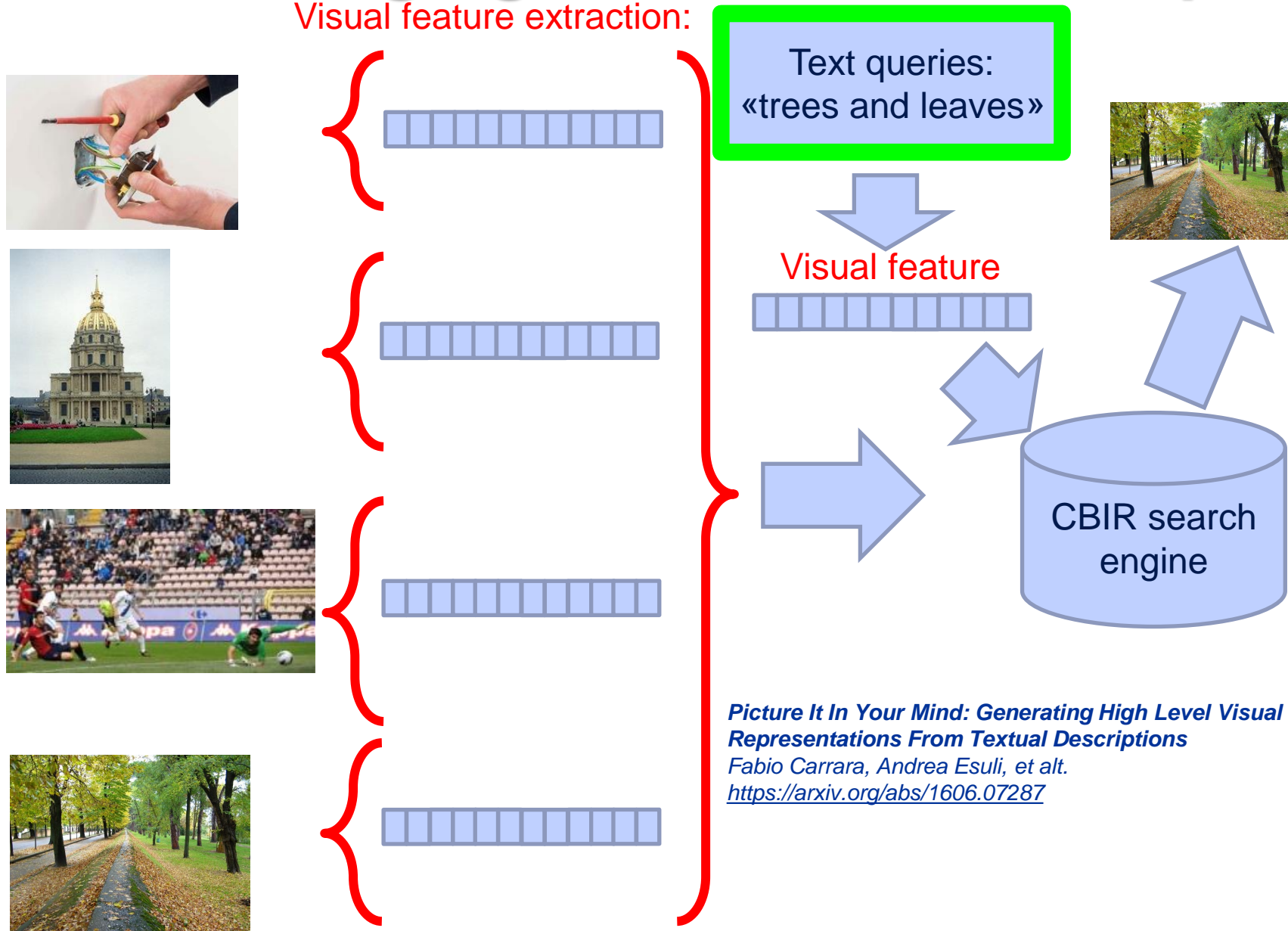


Image selection and tag cleaning



Large scale Image search: leveraging on cross-media rep.

Visual feature extraction:



Picture It In Your Mind: Generating High Level Visual Representations From Textual Descriptions
Fabio Carrara, Andrea Esuli, et al.
<https://arxiv.org/abs/1606.07287>

Cross-media search



- Cross-media search
- <http://virserv101.isti.cnr.it/ImageSearch/>
 - Very early prototype!!!



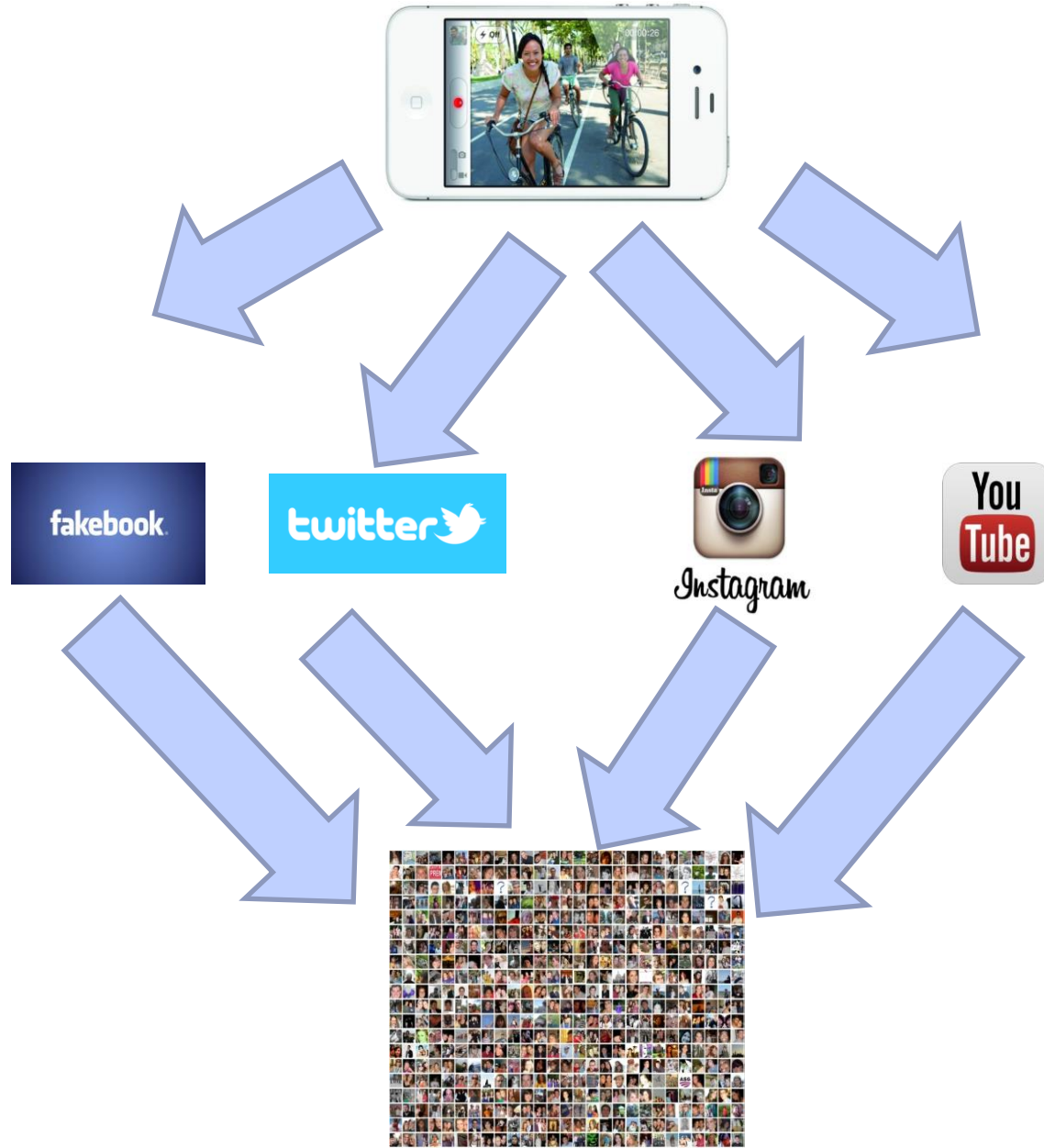
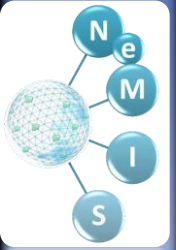
A screenshot of an image search interface. At the top left is a magnifying glass icon over a stack of photos. To its right is a search bar containing the text "spider". Above the search bar are five small thumbnail images: a spider, a green plant, a black spider, a red sports car, and another red sports car. Below the search bar is a navigation bar with three buttons: "Search by Image", "Search by URL", and "Random". The main area displays a grid of search results. The first row contains five images of red sports cars, each with a "Go to Page" link below it. The second row contains five more images of red sports cars, also with "Go to Page" links. The third row is partially visible, showing the top of several more images.

Overview of the keynote

- Managing and searching large scale MM repositories
- **Social Media Analysis**
- Image recognition and Mobile Interaction on a large scale
- Applications of Face recognition techniques



Multimedia and social networks:



Multimedia and social networks: issues

- From text to multimedia in social networks
 - People post pictures, and videos
 - People generate and share media with their mobile phone
 - Multimedia is poorly annotated
 - Multimedia is not easily searchable or exploitable



What information can be extracted?

- Very high value in multimedia content
 - Security
 - Identify risks or provide information
 - Quasi real-time news
 - Get information from people witnessing an event in real time
 - Marketing
 - What are the new emerging trends?
 - Entertainment
 - People spend a lot of time with on-line media. What are they looking for?
 - Human behaviour analysis
 - What do people do in this moment.

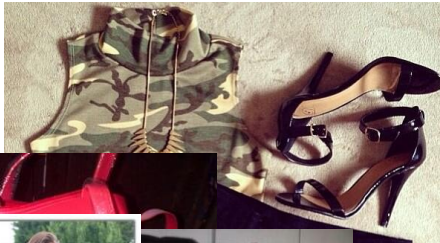
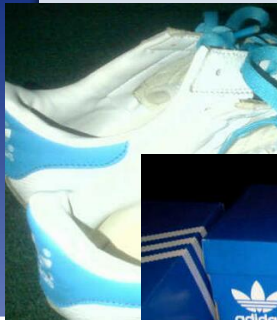




Boston bombing

Paris terrorist attack

Security / quasi real-time news



Market trends



- Entertainment
- Behaviour
- Events



Paris



Polizia di Stato

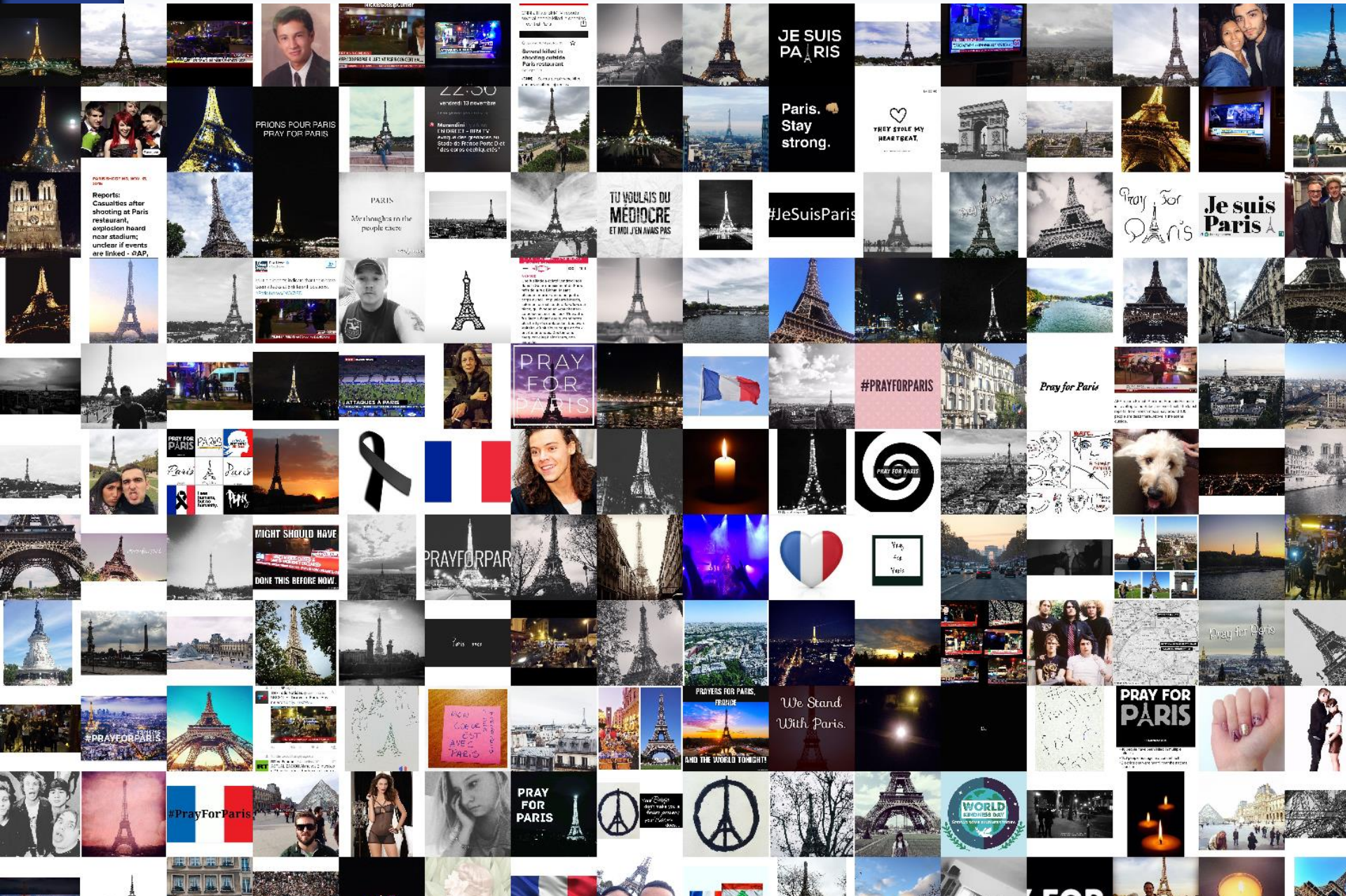
CNR

CRAIM

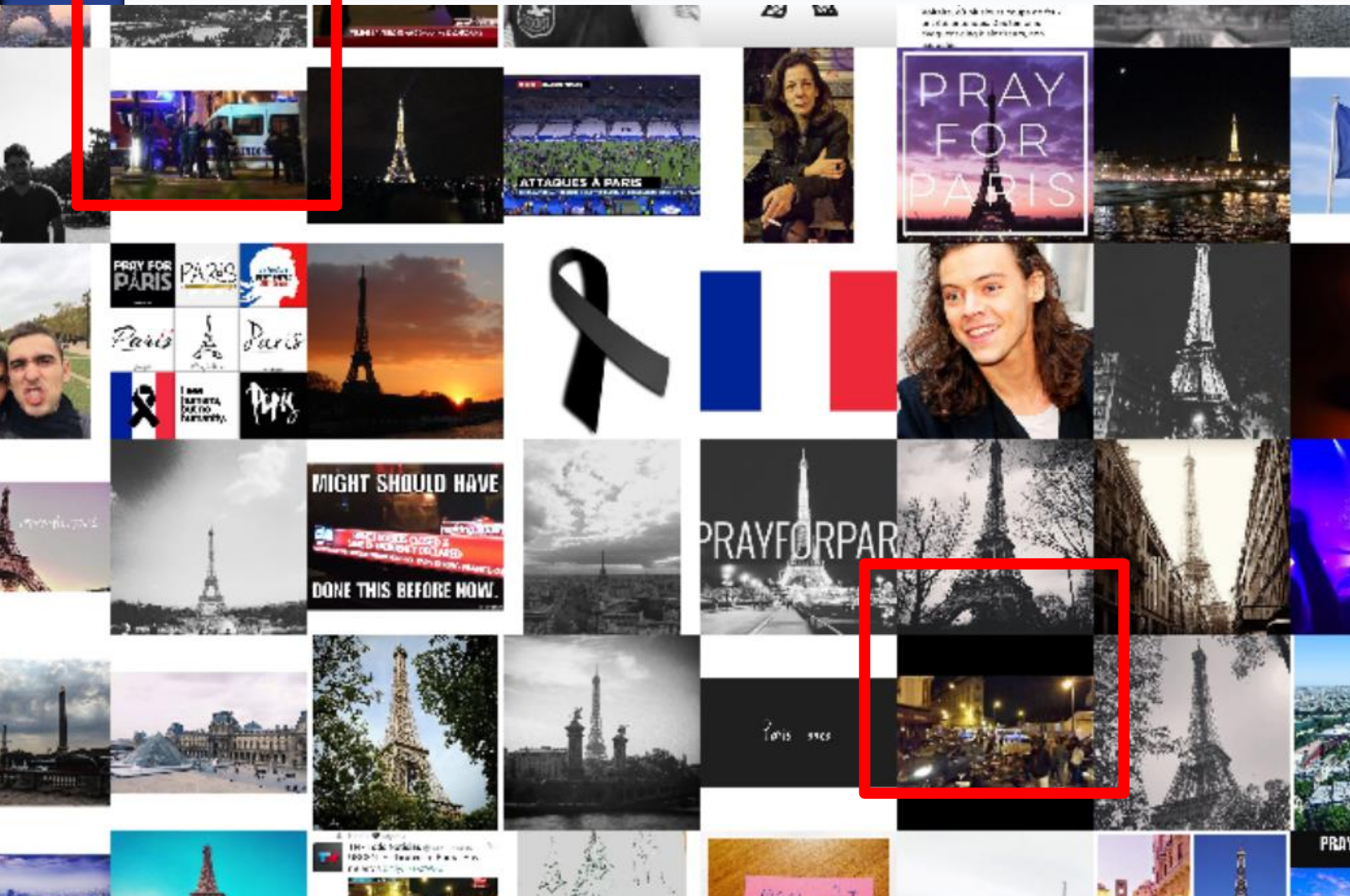
Centro Ricerca e Analisi Informazioni Multimediali

- Project CRAIM, funded by the Italian Ministry of Interior
 - Deep learning techniques for analysis of multimedia material on a very large scale
 - Social media
 - Web media

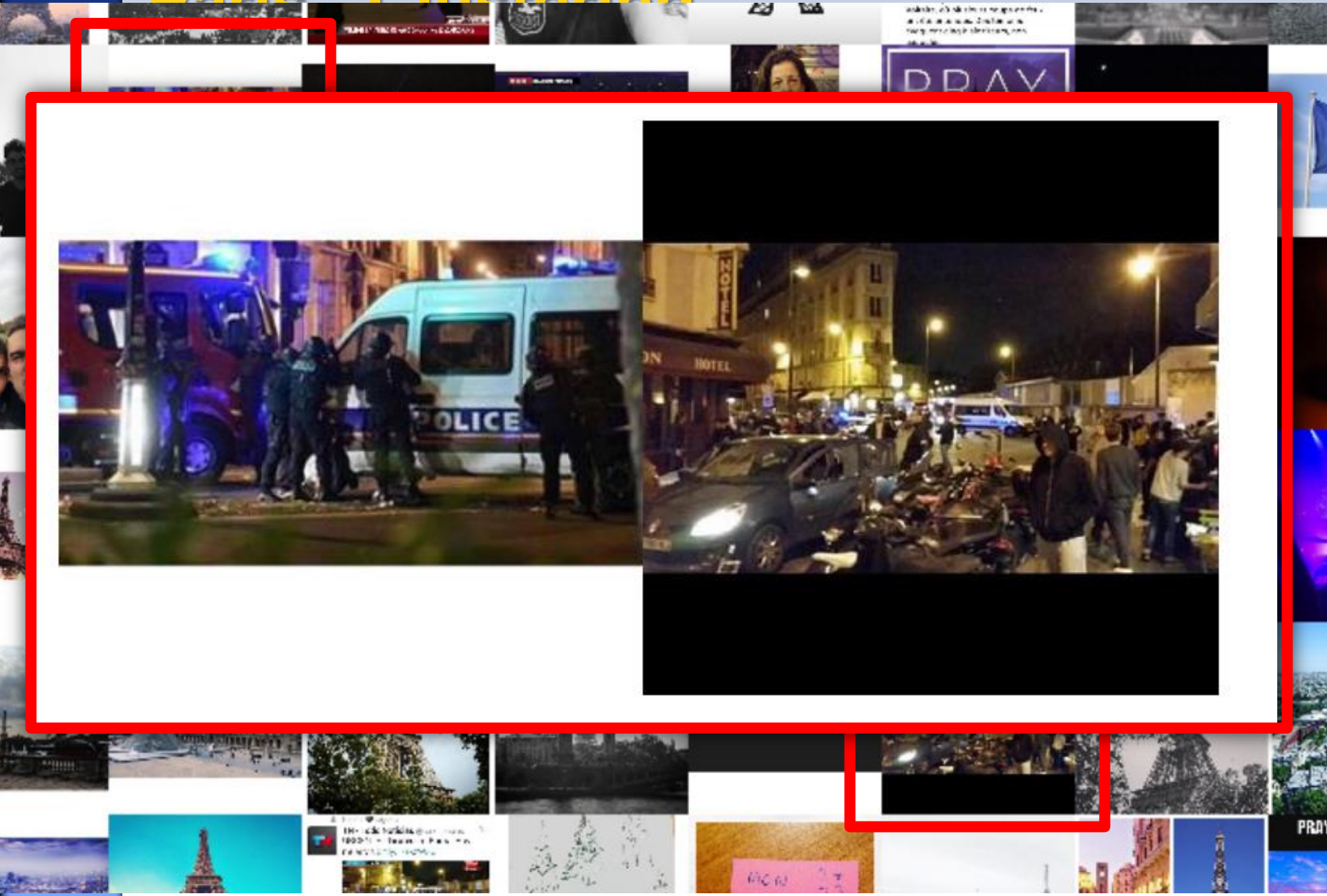
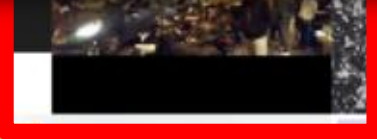
Paris – Near Duplicates Removal



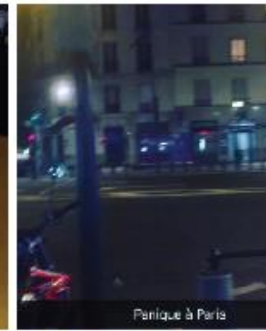
Paris - Clustering



Paris Clustering



Paris – Relevant Images



Parique à Paris



Paris – Content-Based Image



Results:



Fourth Shooting
in !

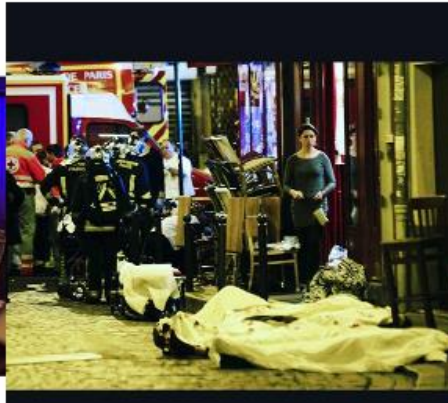
BFM TV BFMTV @BFMTV

10m

Paris – Content-Based Image



Results:

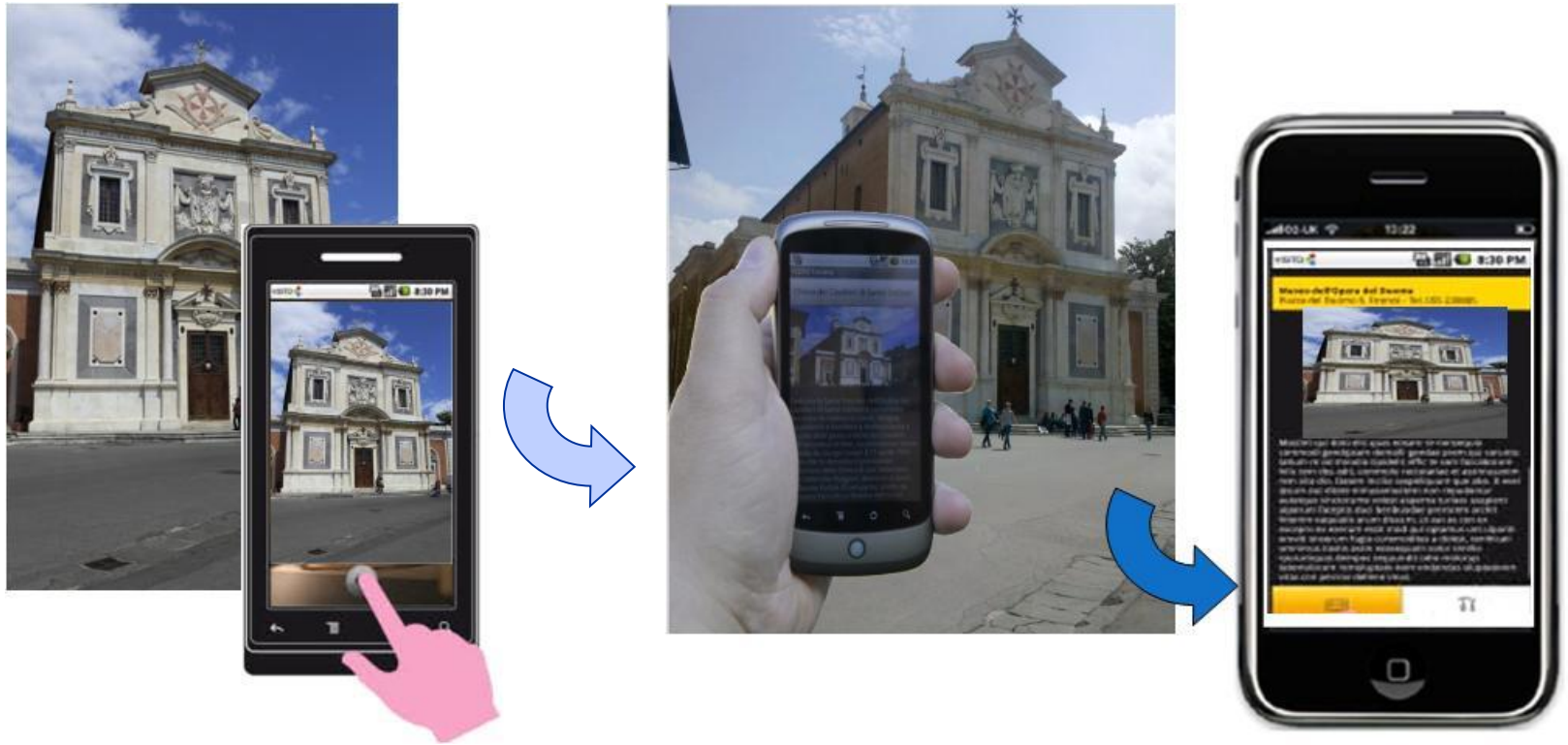


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Image recognition on mobile phones



To provide tourists with immediate access to information related to monuments and artworks



VISITO Tuscany – Visual Recognition



VeMIR: just point you smartphone on what is of your interest



**Visual
Engines**

www.visualengines.com



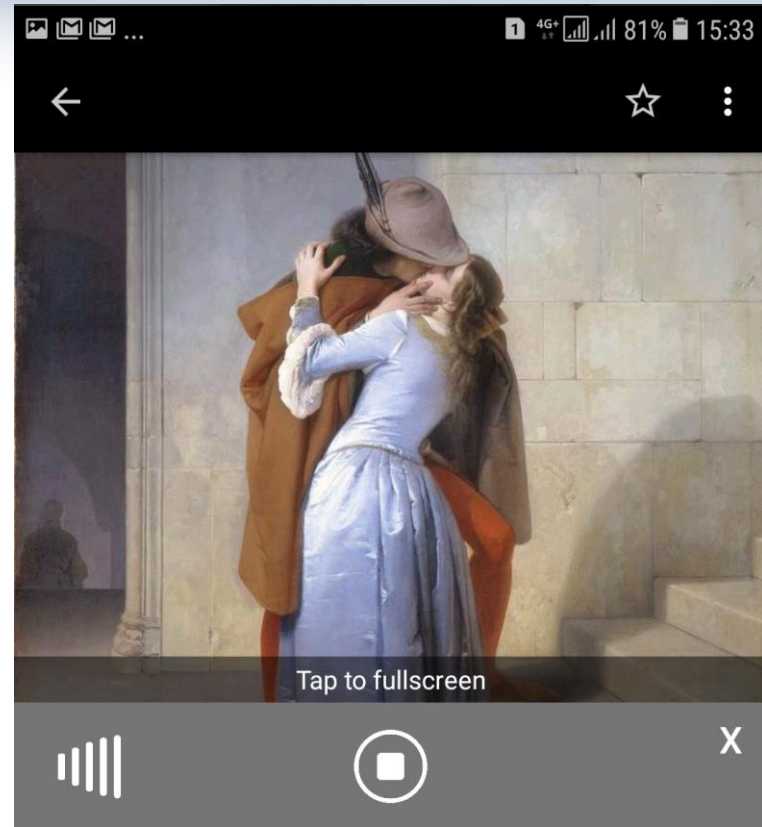
VeMIR



Image recognition for mobile museum guides



Mobile app for the
«Pinacoteca di Brera» in Milan



The Kiss

Francesco Hayez

Year: 1859

Materials/technic: Olio su Tela

Size: cm 112 × 88

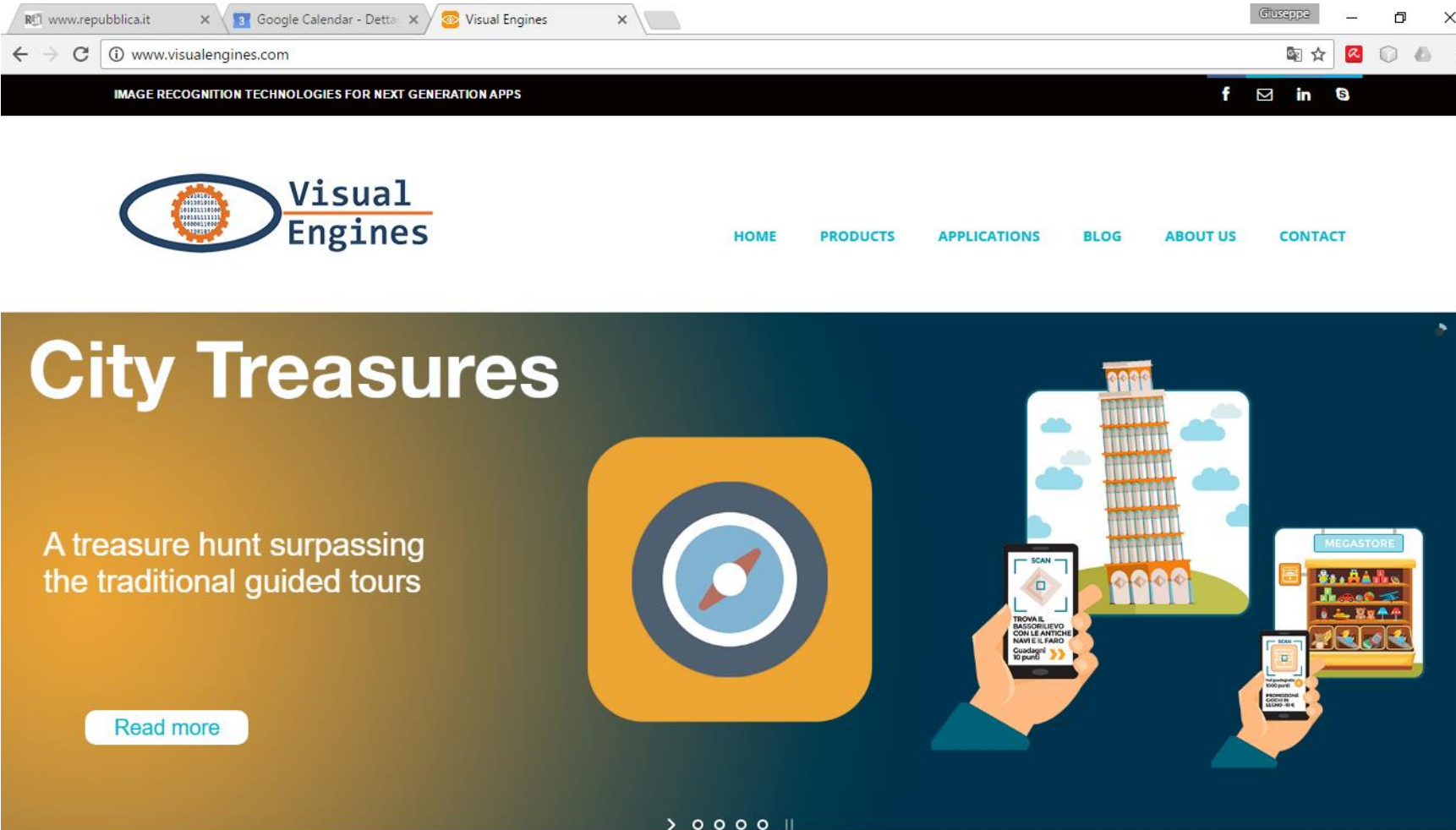
Position: Palazzo Brera - Primo Piano - Sala XXXVII

Description:

The canvas was shown at the Brera Exhibition of 1859 which, held a few months after the entry of Victor Emanuel II and Napoleon III into Milan, celebrated the successful conclusion of the struggles



Visual Treasure Hunt



The screenshot shows a web browser with the URL www.visualengines.com. The page features the Visual Engines logo and a navigation menu with links for HOME, PRODUCTS, APPLICATIONS, BLOG, ABOUT US, and CONTACT. The main content area is titled 'City Treasures' and includes the text 'A treasure hunt surpassing the traditional guided tours' and a 'Read more' button. An illustration depicts a hand holding a smartphone displaying a 'SCAN' interface with a target icon and instructions in Italian: 'TROVA IL SACROBILIEVO CON LE ANTICHE NAVI E IL FARO Guadagni 10 punti!'. Another hand holds a smartphone displaying a 'MEGASTORE' interface with various items. A large orange square with a compass icon is also visible.

www.repubblica.it x Google Calendar - Detta x Visual Engines x Giuseppe

www.visualengines.com

IMAGE RECOGNITION TECHNOLOGIES FOR NEXT GENERATION APPS

Visual Engines

HOME PRODUCTS APPLICATIONS BLOG ABOUT US CONTACT

City Treasures

A treasure hunt surpassing the traditional guided tours

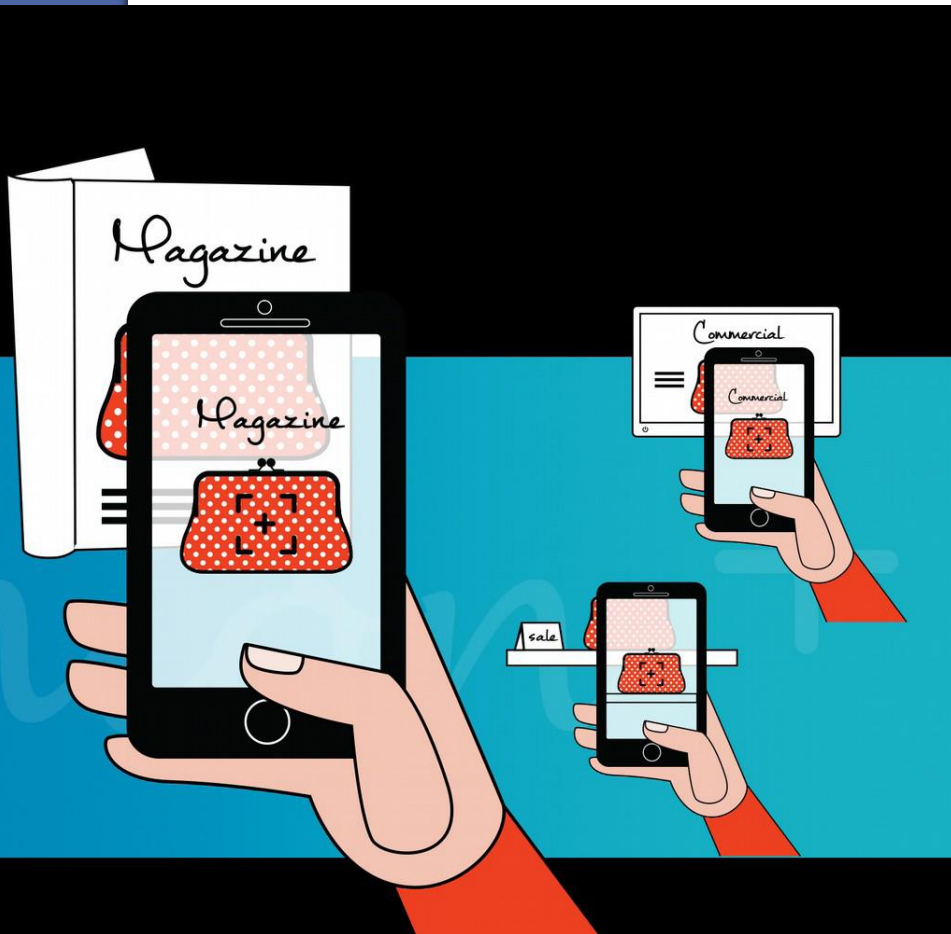
Read more

TROVA IL SACROBILIEVO CON LE ANTICHE NAVI E IL FARO Guadagni 10 punti!

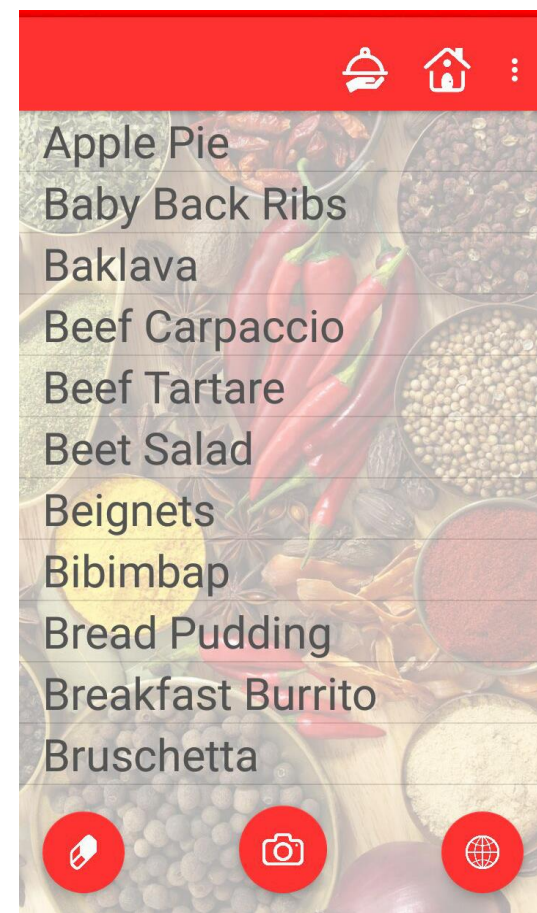
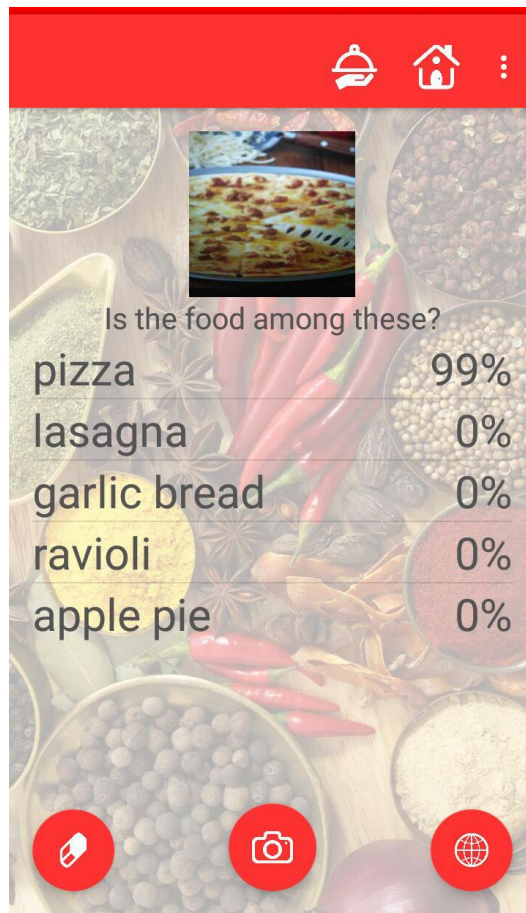
MEGASTORE

<http://www.visualengines.com>

Fashion



Food recognition



Overview of the keynote

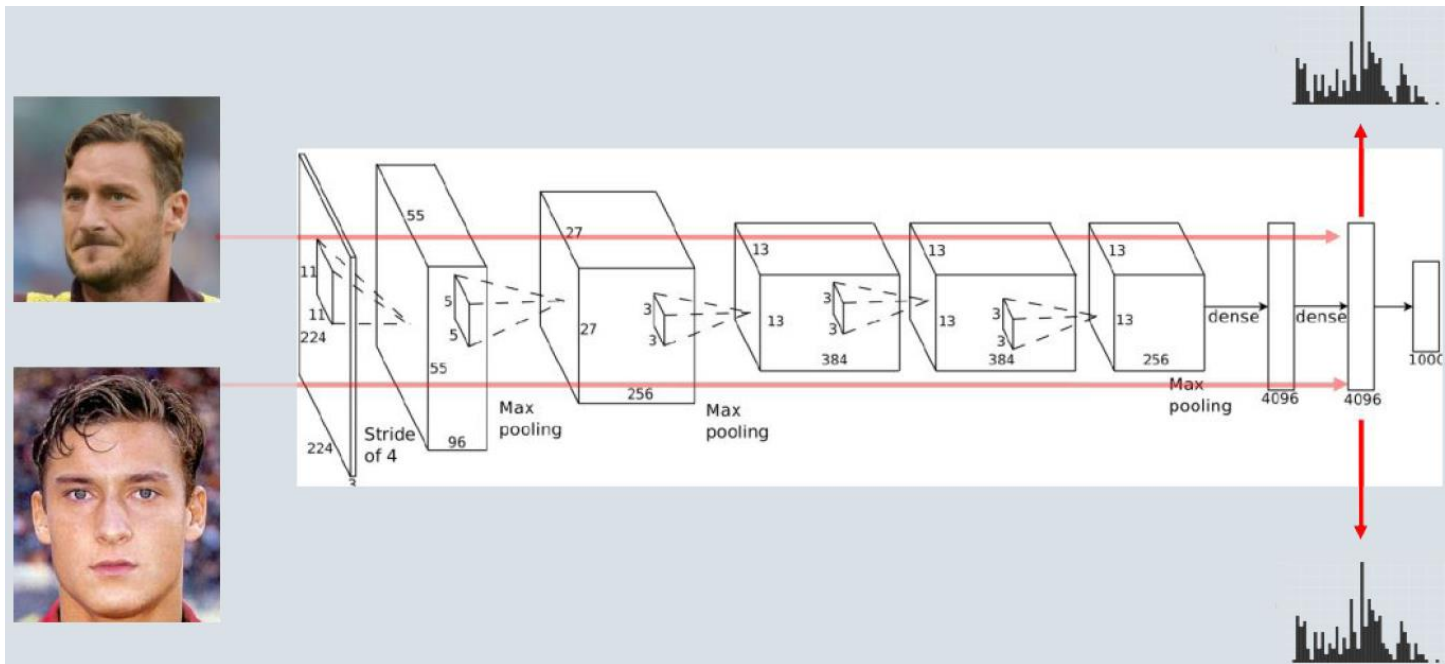
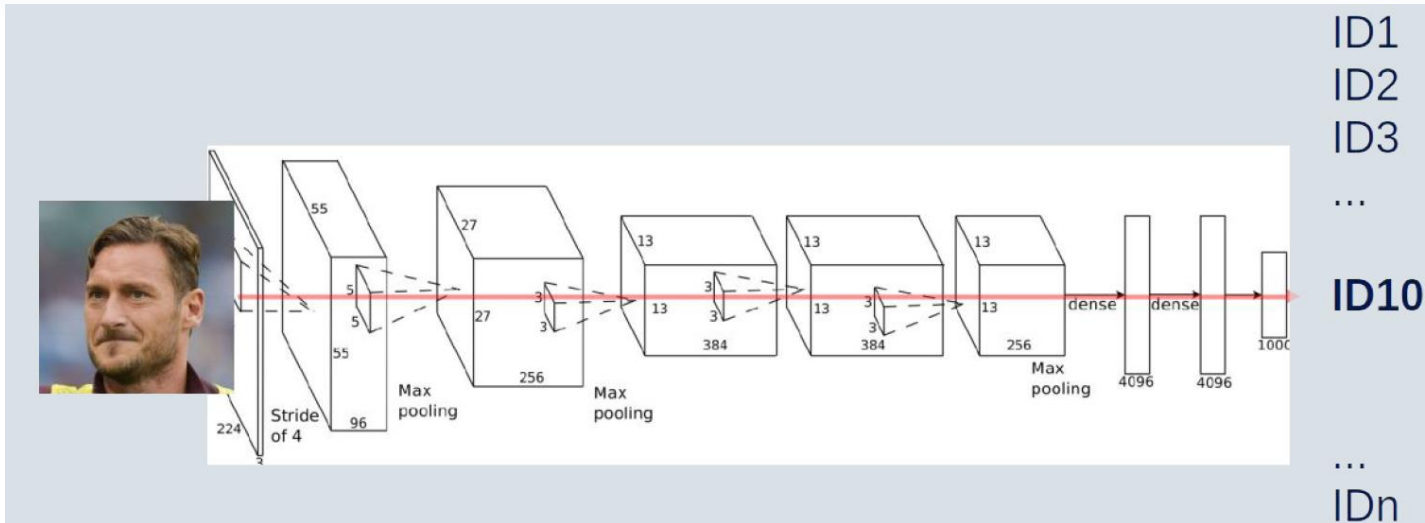
- Managing and searching large scale MM repositories
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Face recognition/verification



Face recognition/verification



Face recognition/verification issues

- Multi resolution

- Training set are often high resolution
- Test images are often very poor resolution



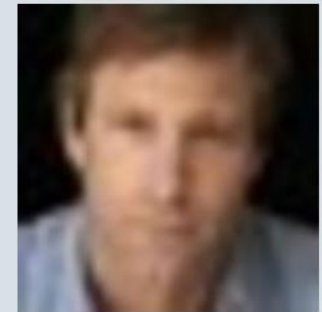
Original



Ifw_160



Ifw_64



Ifw_32



Ifwcrop64

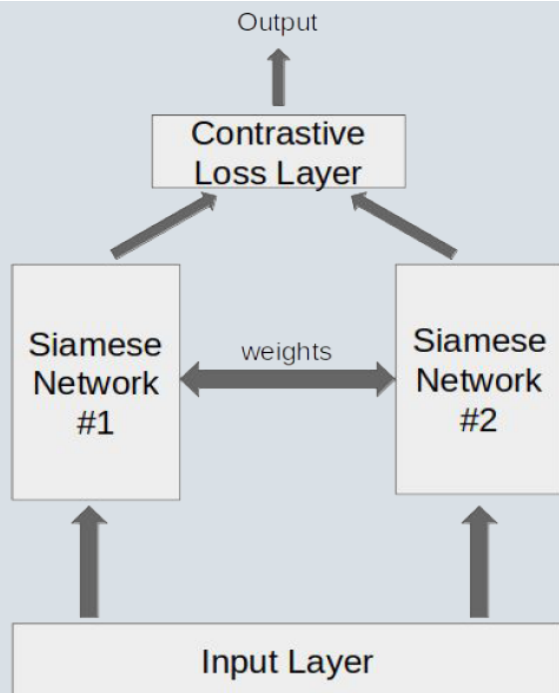


Ifwcrop32



Face recognition/verification issues

- Dealing with multiple resolutions



- Distance learning rather than face identification
 - adding an embedding layer
 - using a siamese network
- Starting from Vggface architecture and weights
- The input is a couple of faces
- The output is 1 if equal, 0 otherwise



- Face recognition:
 - <http://goo.gl/9DTEJG>
- Very early prototype!!!



Report of the video analysis performed on Jan 18, 1970, 5:11:09 PM for the video got_trailer.
 Click on Play Video button to play the video at the exact frame where the detection occurred.
 22 people found, 83 total matches.

Select People To Search:

Sort Results by: Time Score

All Arya_Stark Bran_Stark Catelyn_Stark Cersei_Lannister Daenerys_Targaryen Ellaria_Martell Hodor Jaime_Lannister Joffrey_Lannister Jon_Snow Jorah_Mormont Melisandre Ned_Stark Petyr_Baelish Ramsay_Bolton Robb_Stark Robert_Baratheon Sansa_Stark Stannis_Baratheon The_Hound Tyrion_Lannister Ygritte

Tyrion_Lannister, distance: 0,342

Identified on video at 11,7 sec.

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Ned_Stark, distance: 0,436

Identified on video at 23,6 sec.

[Play Video](#)

Catelyn_Stark, distance: 0,497

Identified on video at 24,4 sec.

[Play Video](#)

Tyrion_Lannister, distance: 0,542

Identified on video at 27,3 sec.

[Play Video](#)

Ned_Stark, distance: 0,441

Identified on video at 34,4 sec.

[Play Video](#)

Robert_Baratheon, distance: 0,464

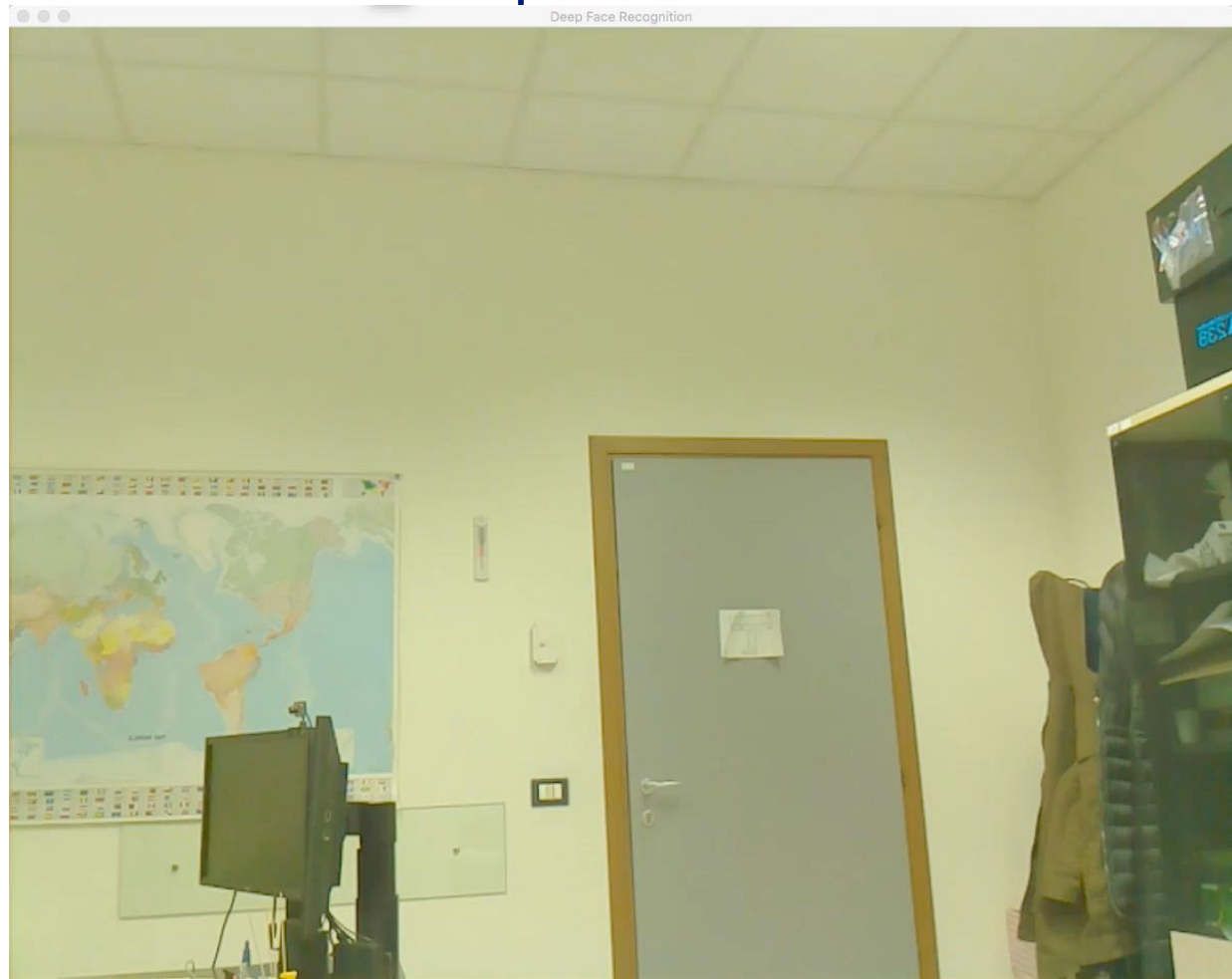
Identified on video at 35,9 sec.

[Play Video](#)



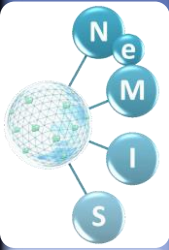
Face recognition for Visual Access Control in restricted areas

- Techniques for face recognition/verification using smart cameras
- To check if unauthorized persons access restricted areas



Conclusions

- **Effective** and **efficient** solutions to Image Retrieval and analysis on a Very Large scale are now available
- **Deep Learning** based techniques for extraction of features produced a step forward in effectiveness
- Several opportunities in **the Creative Industry, Cultural Heritage, Security/Forensic domains**, when dealing with visual information



Questions?



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