

Opening up Audiovisual Archives for Professionals and Researchers

Tinne Tuytelaars

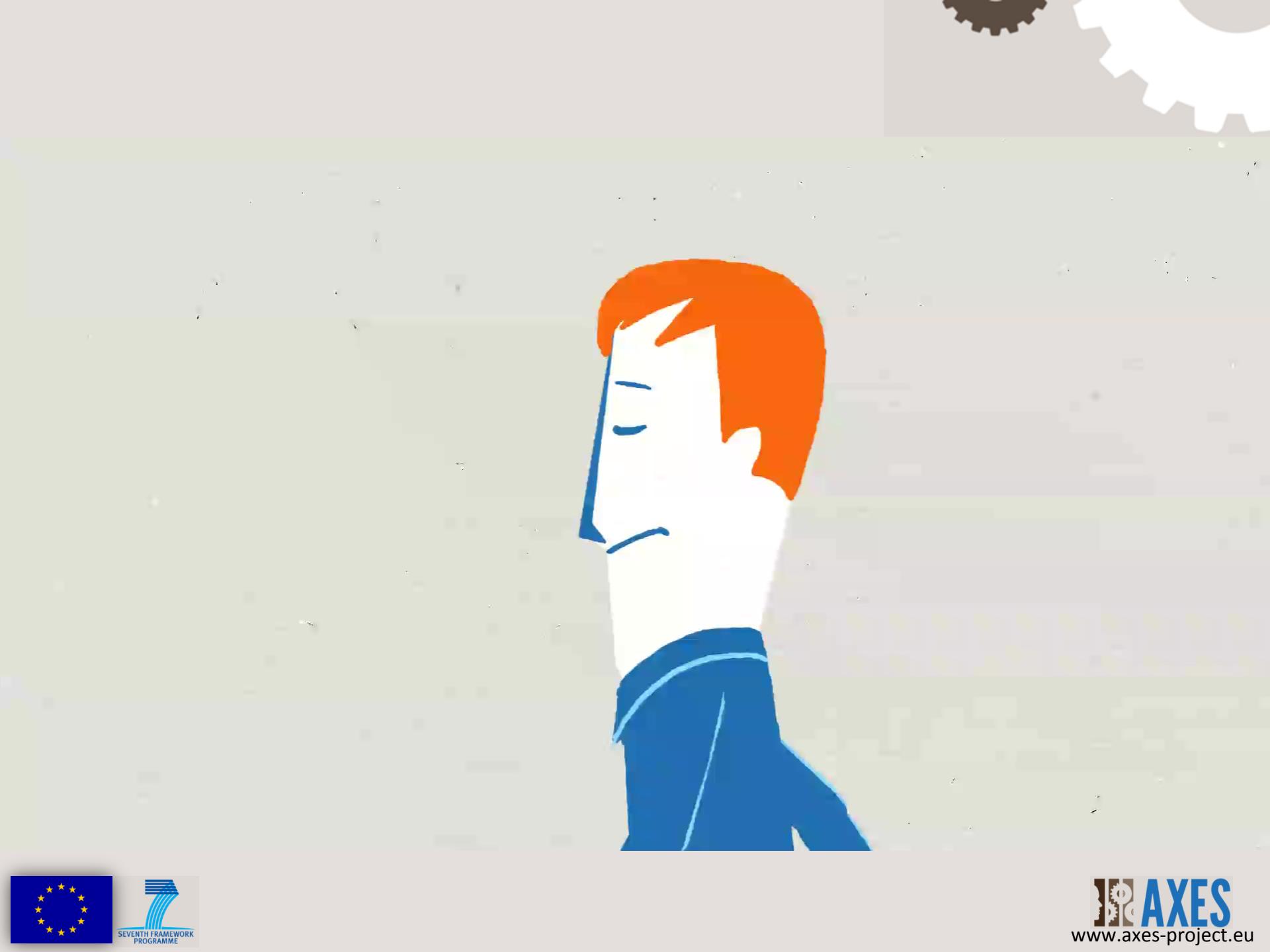
07/1/2014



Overview

- The AXES project
- Audiovisual content analysis
- Demo systems:
 - AXES-PRO
 - AXES-RESEARCH
- Lessons learned, future work





Current situation

- A huge wealth of audiovisual data
- Lots of data in archive virtually irretrievable
- Search/indexing based on metadata manually entered by the archivists



Some causes of irretrievable data

1. Old material from pre-digital era
2. Metadata provided at document-level
3. Ideal annotations do not exist
 - Different uses
 - Different users



Developing tools providing new engaging ways to interact with audiovisual libraries...

Not just search:

Browse

Explore

Experience



... for a multitude of end users...

Media professionals (Y1-Y2)

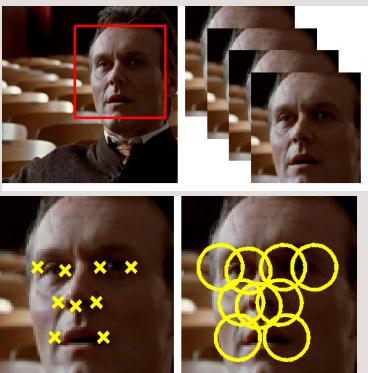
Researchers (Y2-Y3)

Home users (Y3-Y4)



... building on state-of-the-art content analysis techniques...

Computer vision



Speech recognition / audio analysis



Weakly-supervised methods

Search & navigation

A screenshot of the AXES search interface. The left sidebar has an orange header 'AXES INFORMATION'. It includes sections for 'SEARCH ARCHIVE' (with 1,493 segments, 3,087 stories, and 80 programmes), 'MY COLLECTION' (with 1 segment), and 'INDEXES' (listing named persons, geographic locations, named events, and general objects). The main area is titled 'RETRIEVAL RESULT' and shows a list of search results for 'DW News at Nine' from 10-12-1991. Each result includes a thumbnail, title ('DW News at Nine'), and a small icon. Below the list is a video player showing two men shaking hands. A legend at the bottom right defines symbols for named persons, locations, and events.

... building on state-of-the-art content analysis techniques...

People



Places



Events



Object categories



... with a user-centric approach...



... working along 3 axes:

- Users
- Technology
- Content

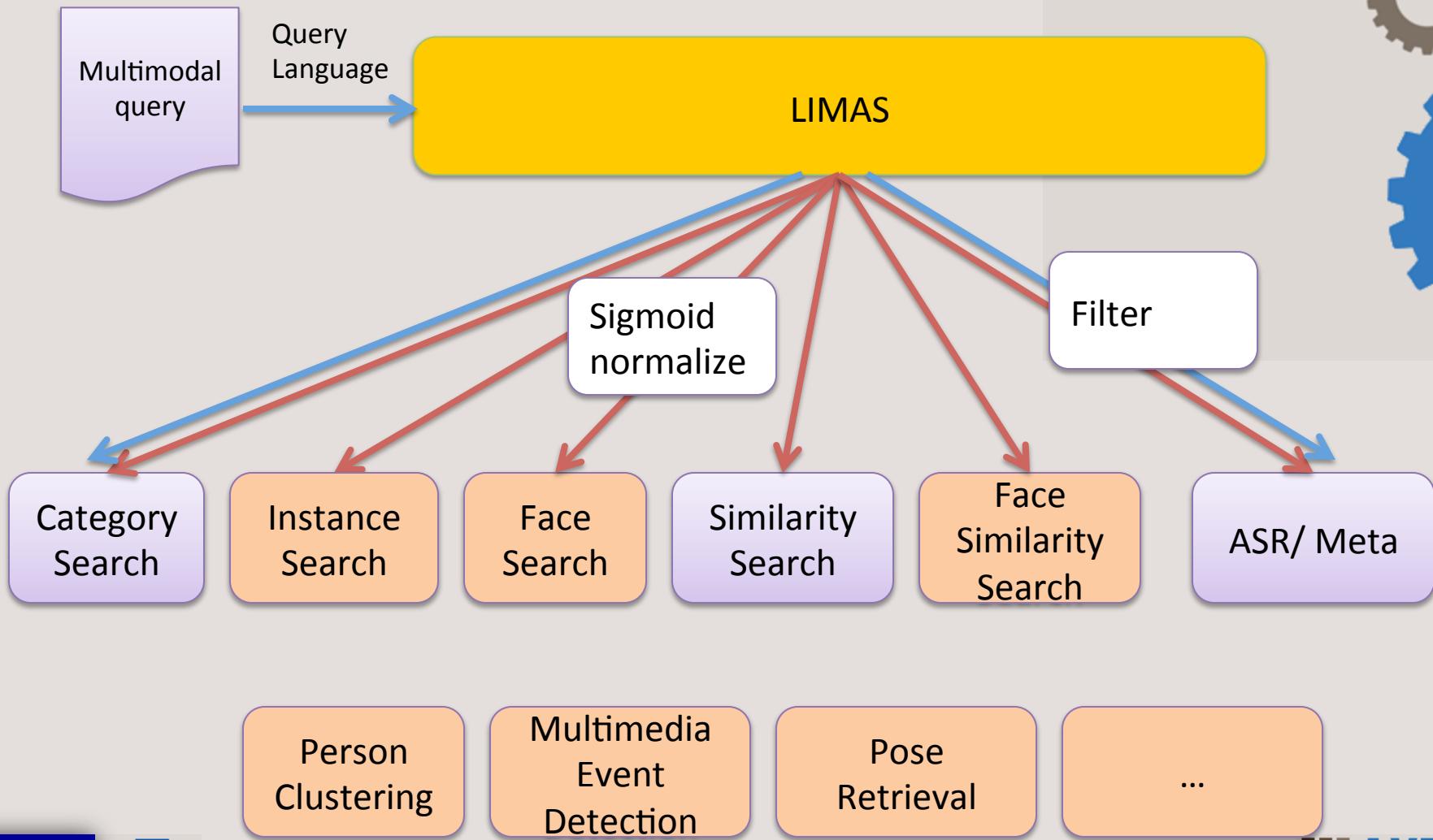


Overview

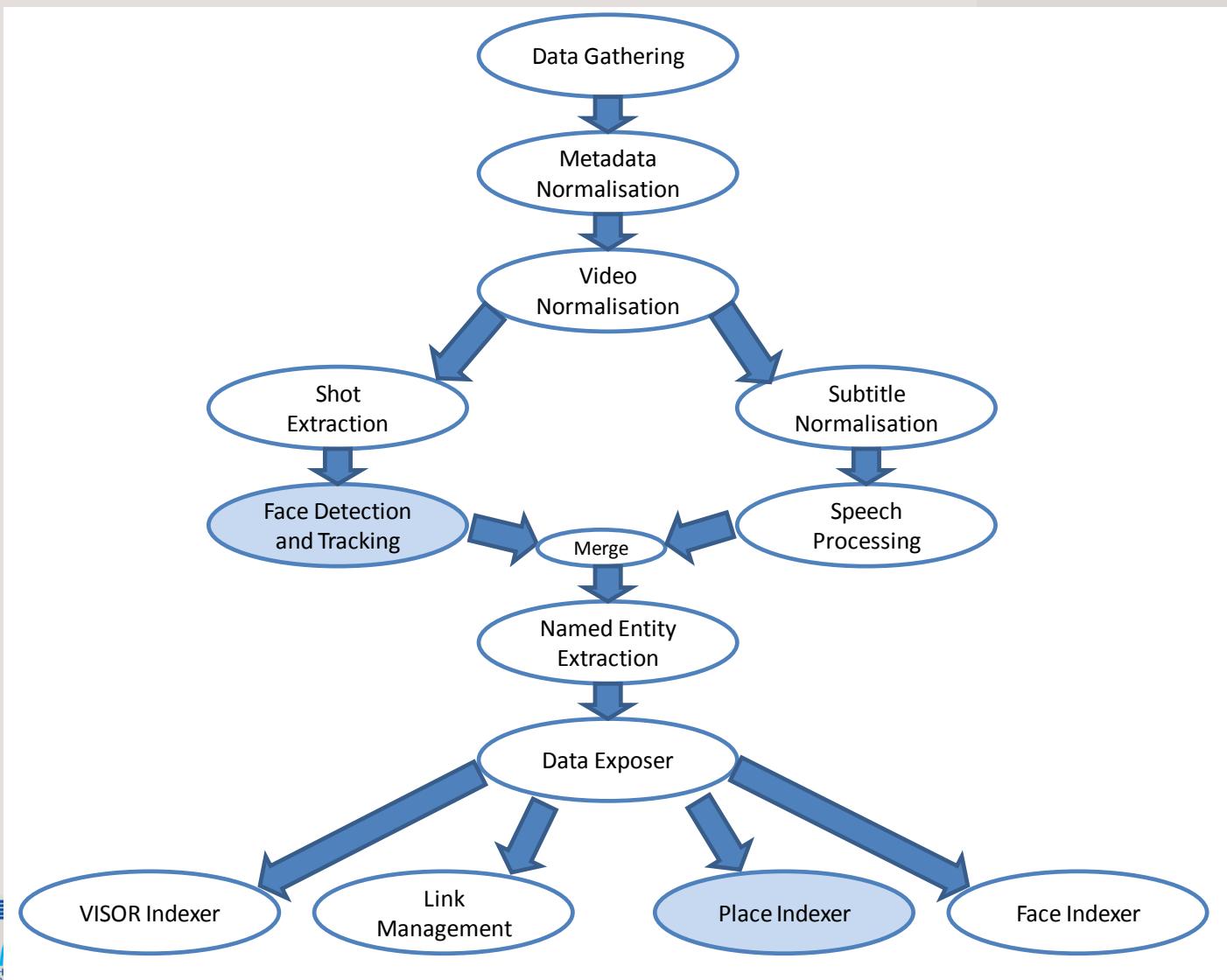
- The AXES project
- **Audiovisual content analysis**
- Demo systems:
 - AXES-PRO
 - AXES-RESEARCH
- Lessons learnt, future work



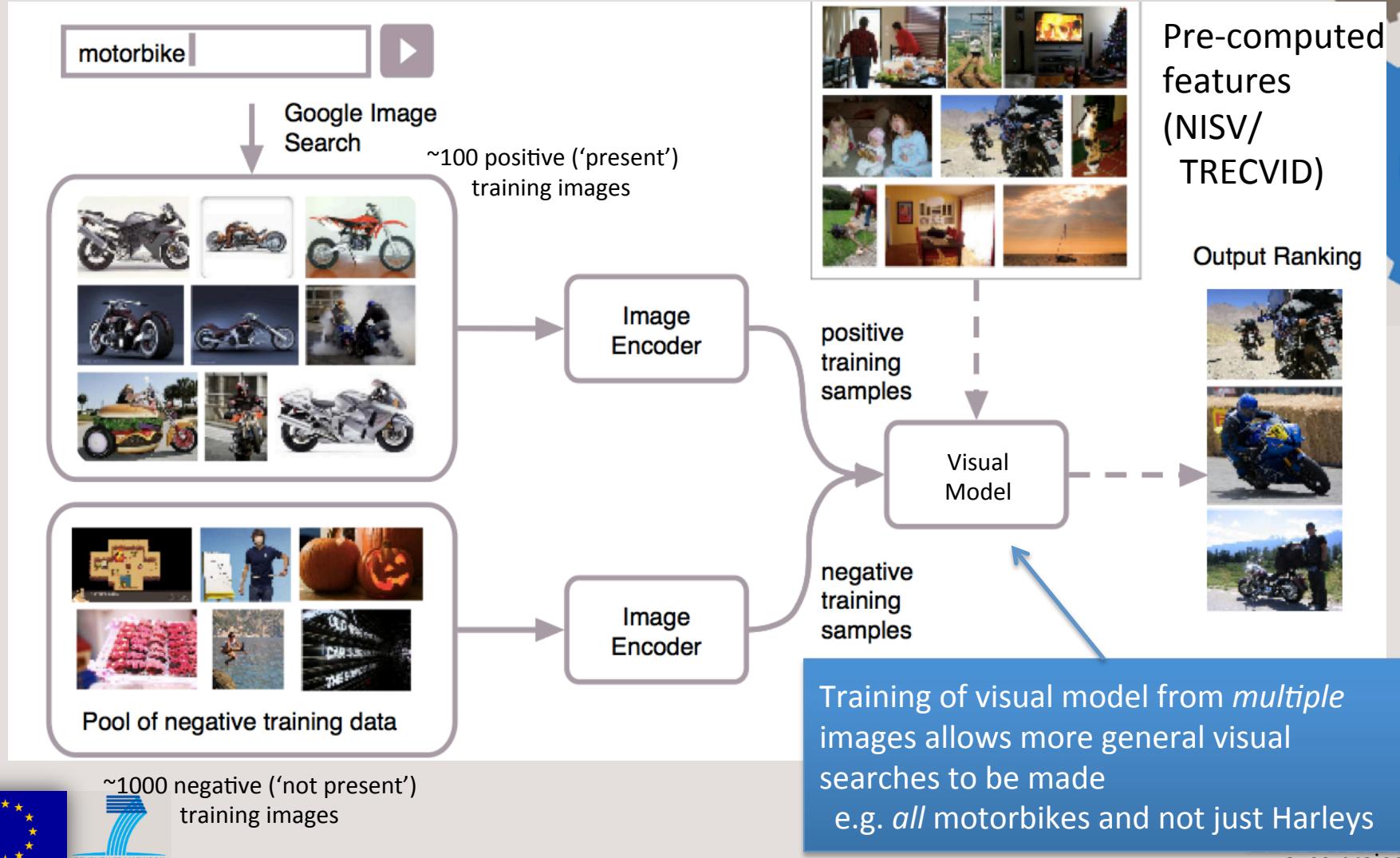
Processing pipeline



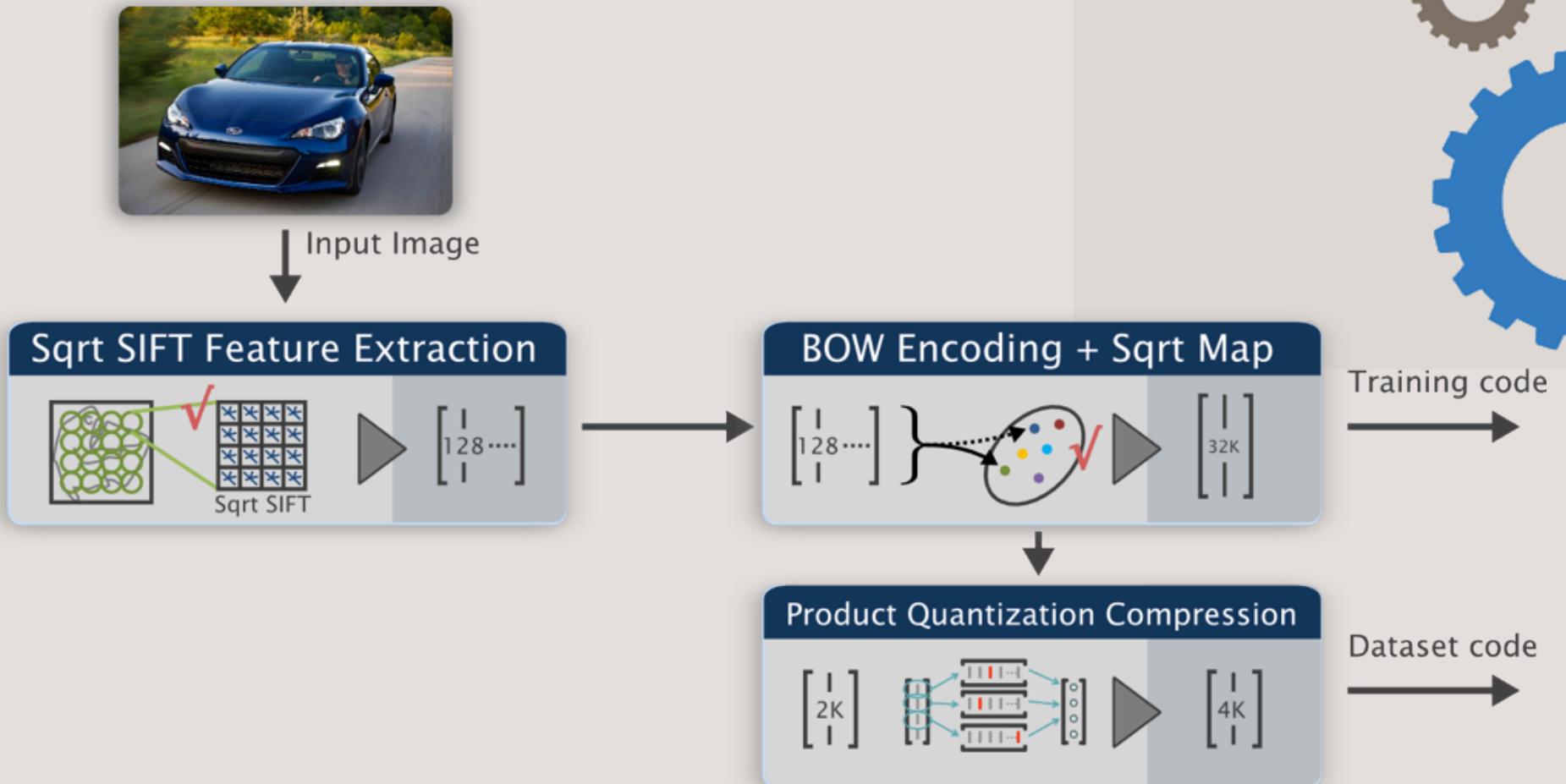
Processing pipeline



On-the-fly Visual Category Search



OTF System Outline

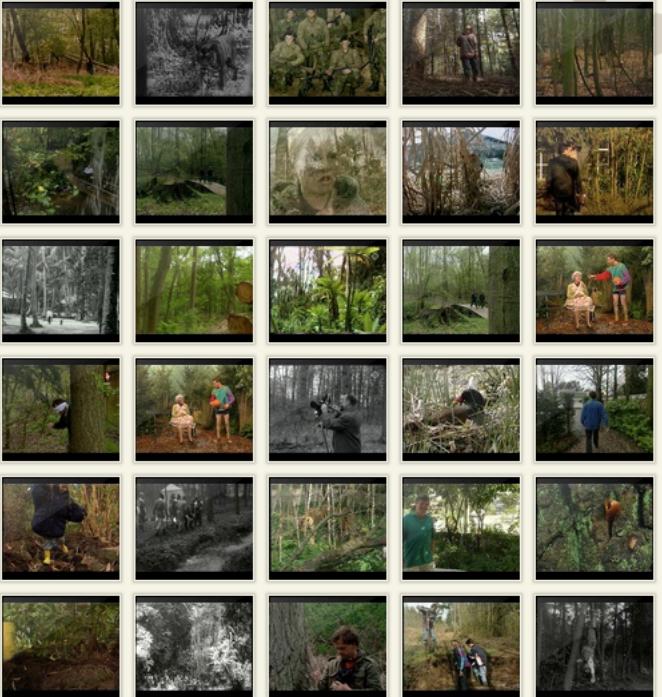


Visual Category Search – Examples

'forest' – NISV

RETRIEVED RESULTS (Found 866 segments in 268 videos. Showing 499 segments)

VIEW: THUMBNAILS | COMPACT | DETAILED | TRAINING IMAGES (76)



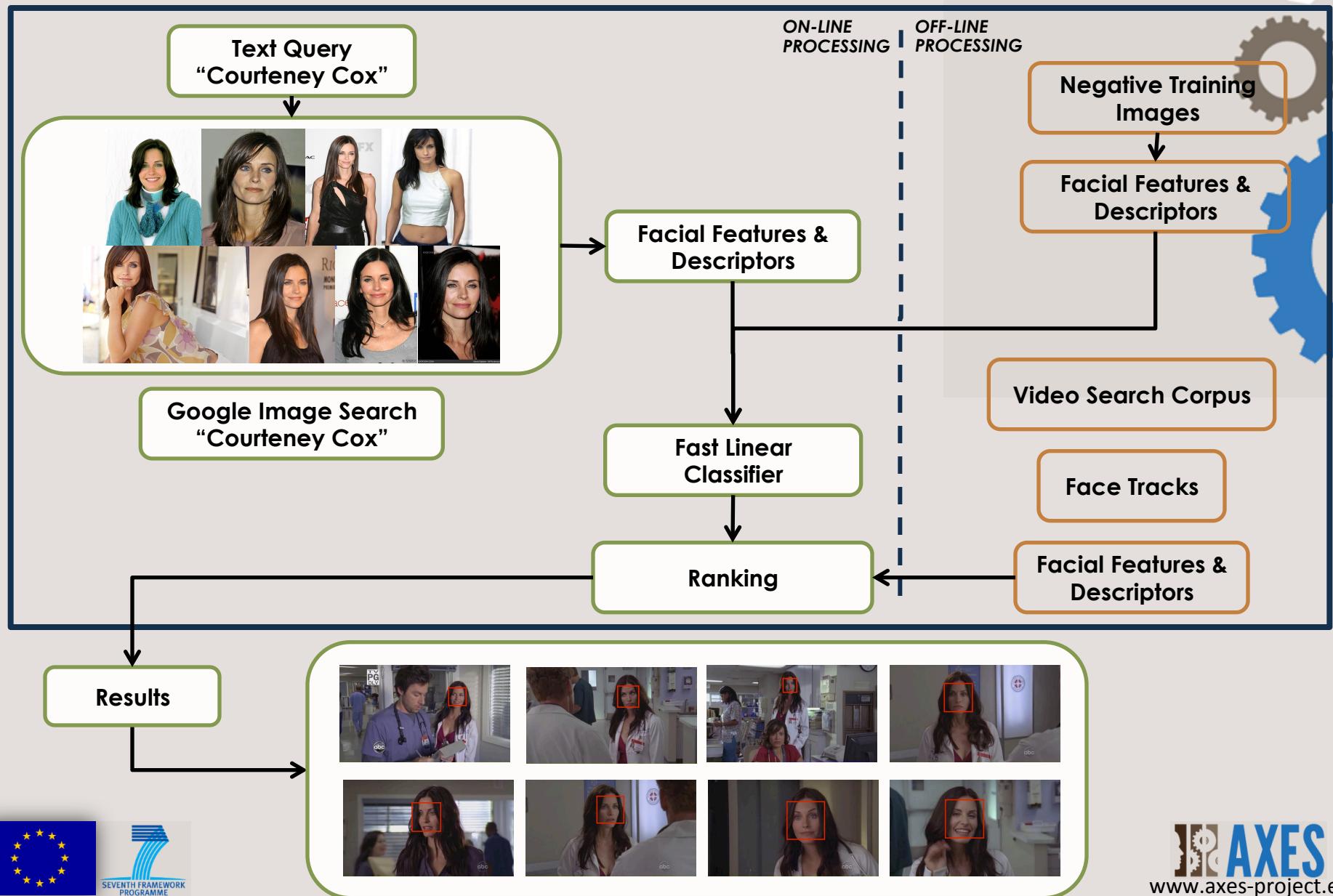
'gothic architecture' – NISV

RETRIEVED RESULTS (Found 775 segments in 306 videos. Showing 499 segments)

VIEW: THUMBNAILS | COMPACT | DETAILED | TRAINING IMAGES (85)

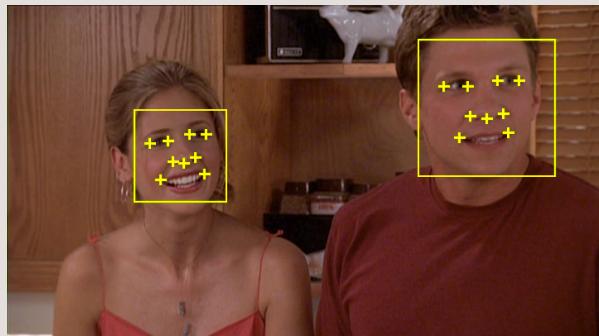


On-the-fly Face Search

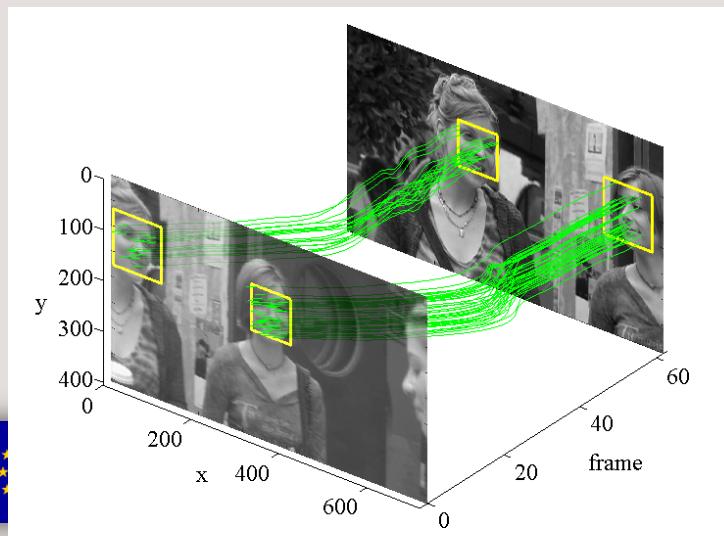


Face Search – Feature Computation

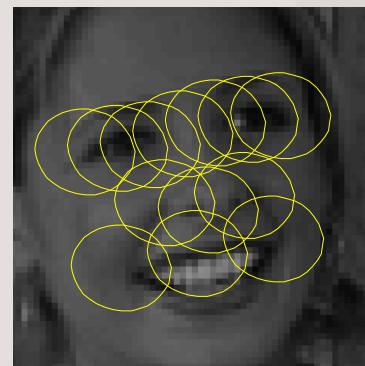
Face detection and facial landmark detection



Faces clustered into tracks



Feature region descriptors

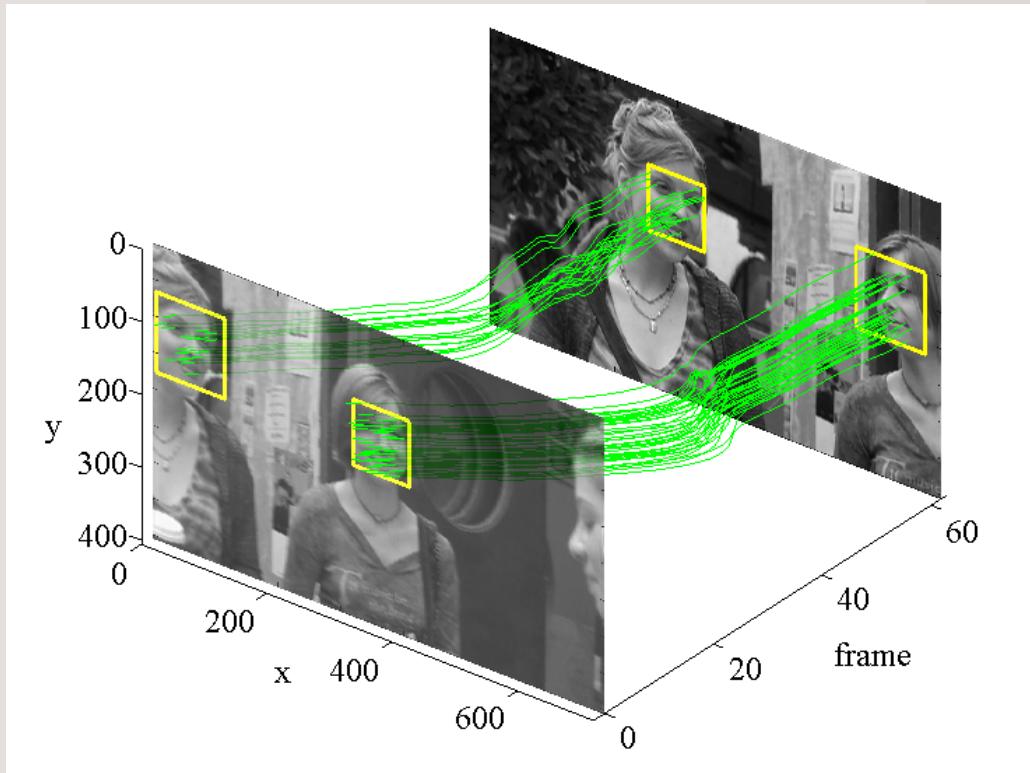


Concatenation

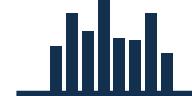
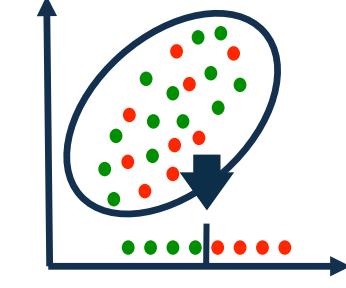
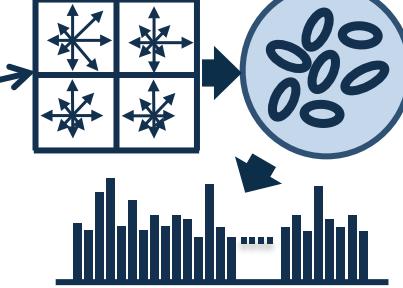
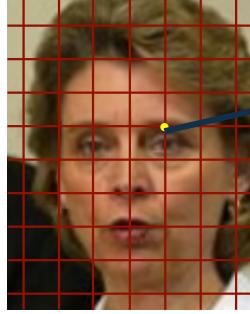
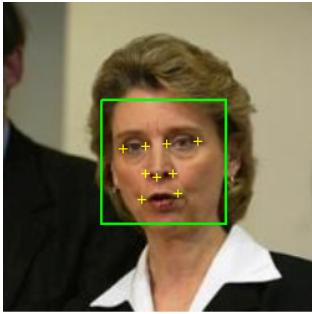


Feature Vector

On-the-fly Face Search



Facial landmark detection → Aligned and cropped face → Dense SIFT, GMM, and FV → Discriminative dim. reduction → Compact face representation

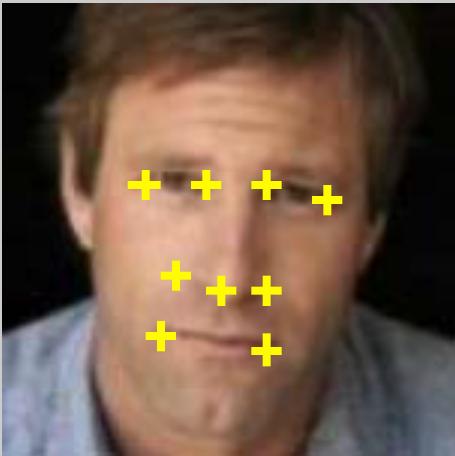


New Face Descriptor

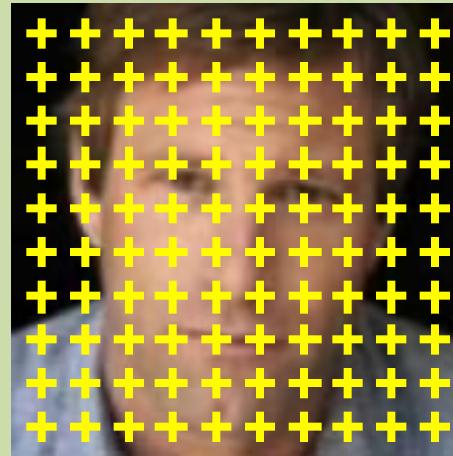
Face descriptor for face recognition

- dense sampling
- relevant face parts learnt automatically
- compact and discriminative

**Current approach
(describe landmarks)**



**New approach
(describe everything)**



Face Category Search – Examples

‘George Bush’ – NISV

‘Spectacles’ – NISV

RETRIEVED RESULTS (Found 799 segments in 258 videos. Showing 499 segments)

VIEW: THUMBNAILS | COMPACT | DETAILED | TRAINING IMAGES (86)

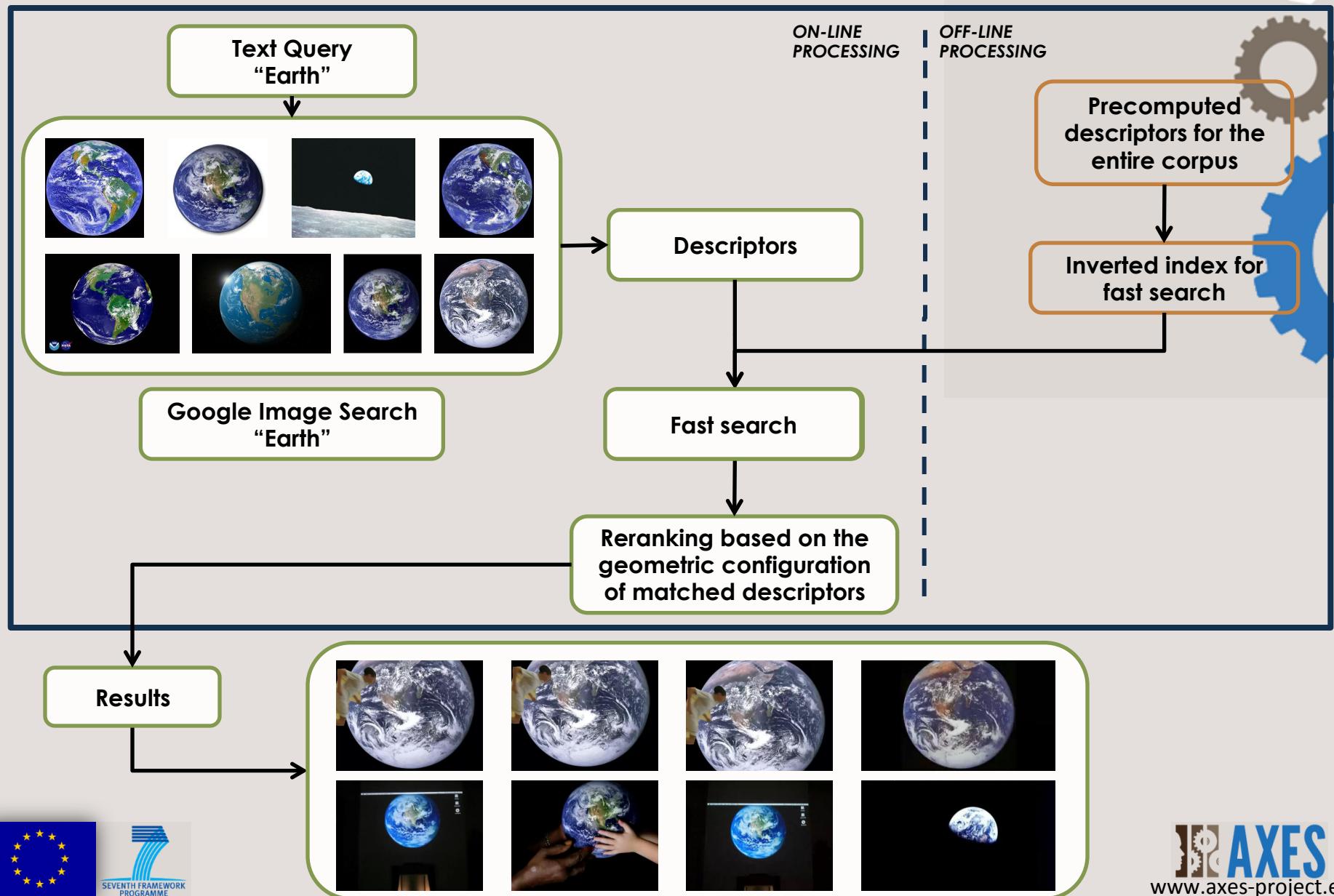


RETRIEVED RESULTS (Found 848 segments in 369 videos. Showing 499 segments)

VIEW: THUMBNAILS | COMPACT | DETAILED | TRAINING IMAGES (87)



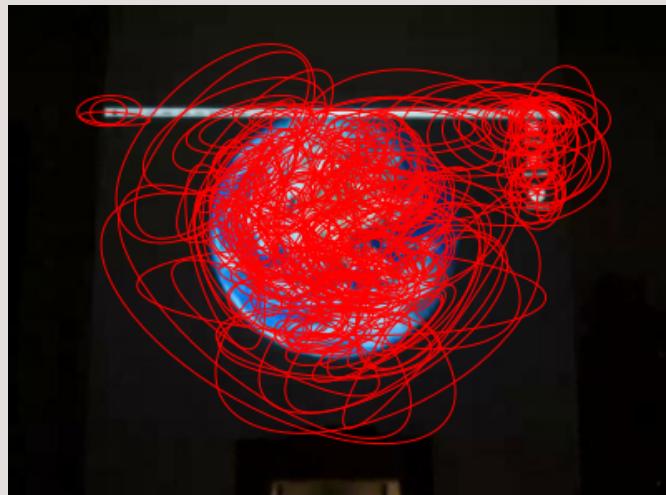
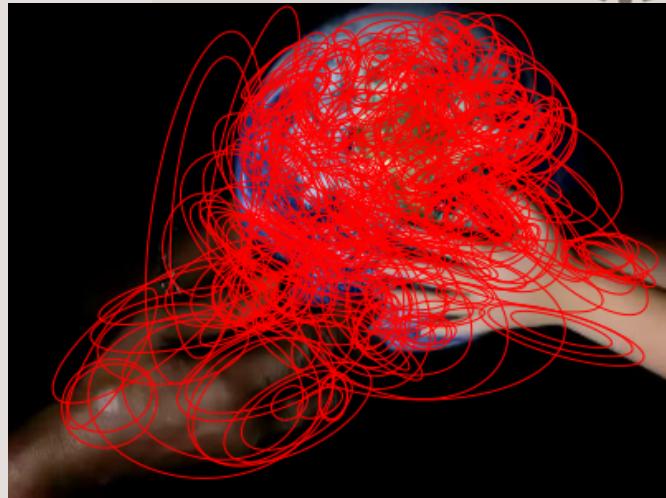
On-the-fly Instance Search



Instance Search: Feature Computation

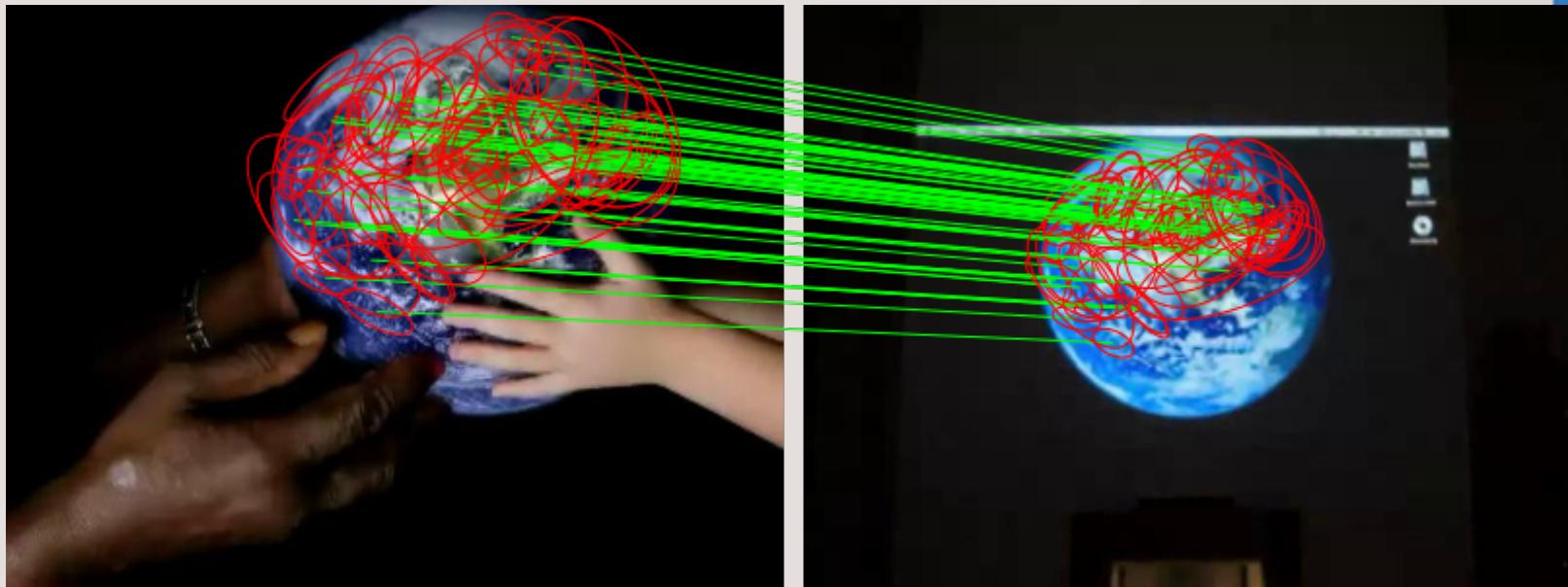


Salient image regions
are detected and a
descriptor is
extracted for each
one

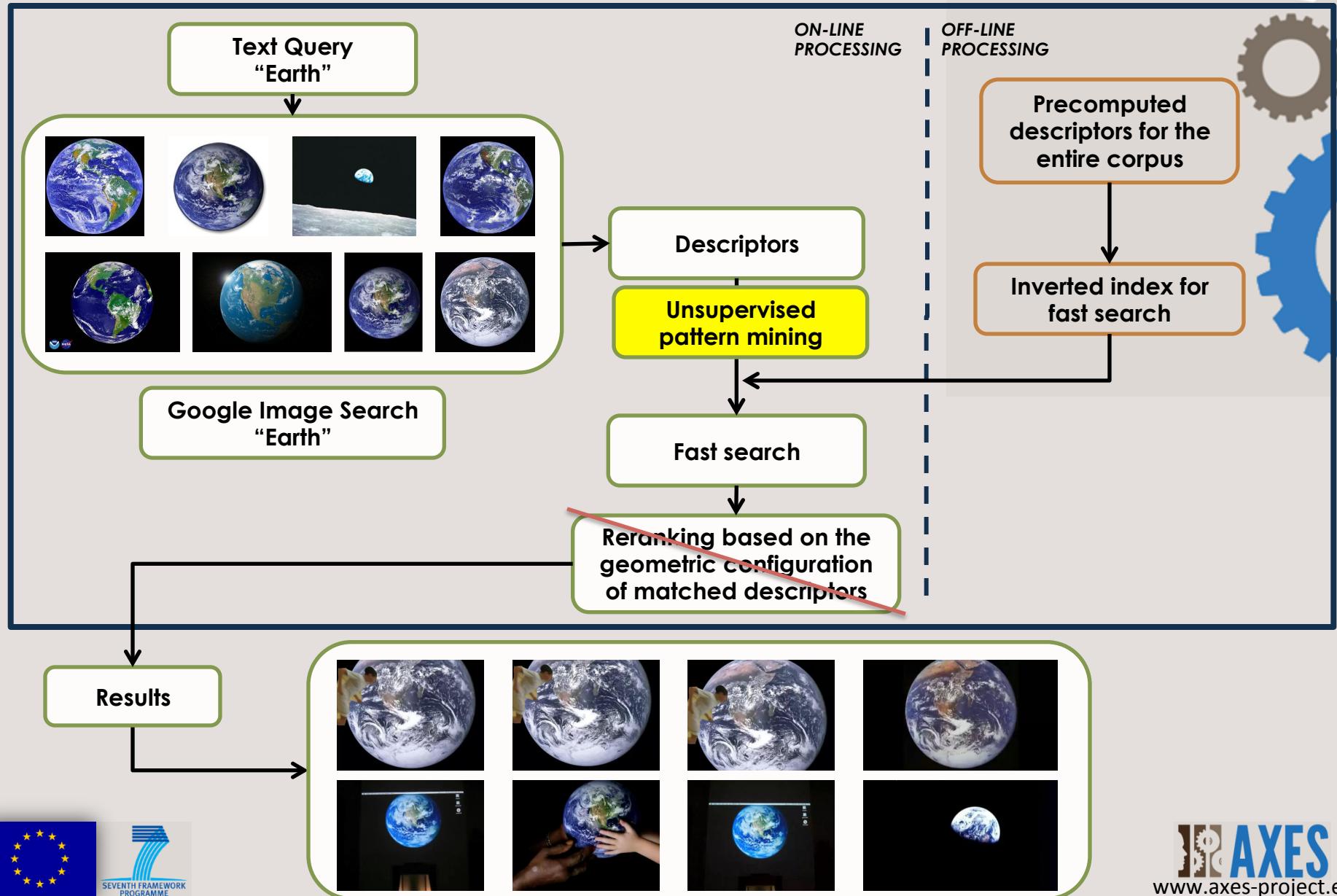


Instance Search: Geometric verification

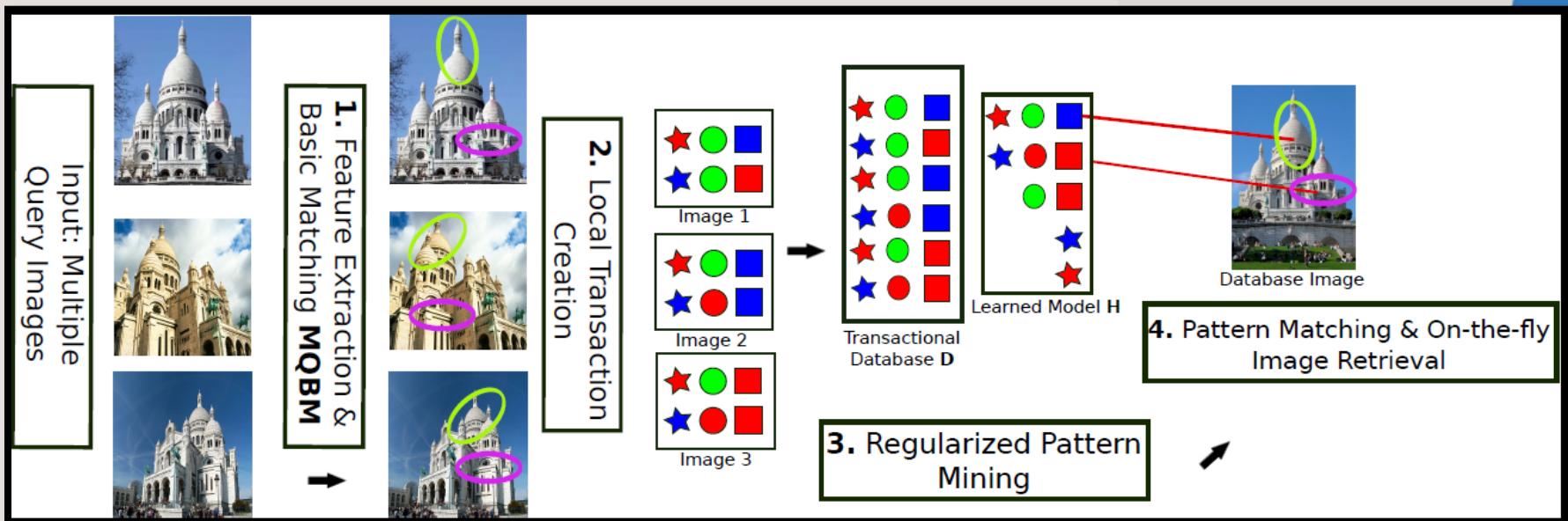
Spatial arrangement of descriptors is used to verify a match



On-the-fly Instance Search - variant



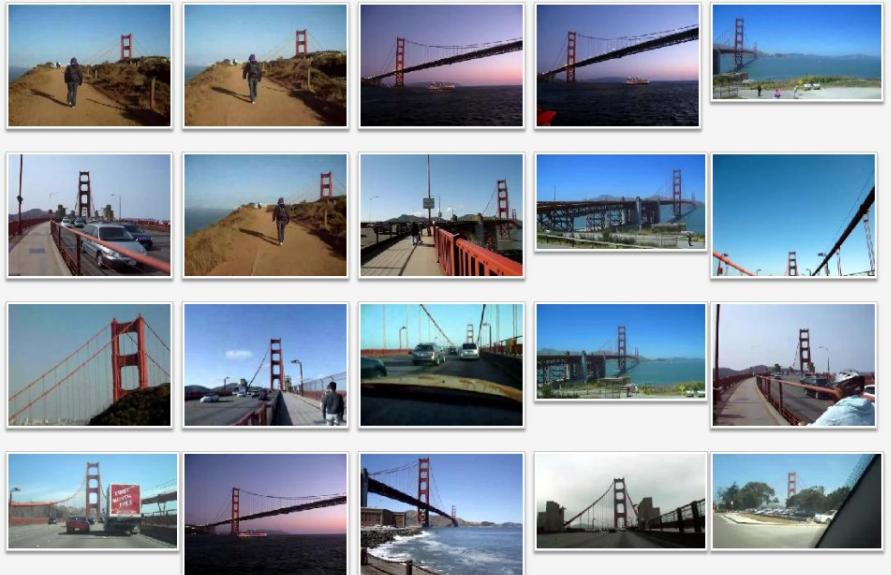
On-the-fly Instance Search - variant



Instance Search – Examples

‘Golden Gate Bridge’

– TRECVID 2012 INS



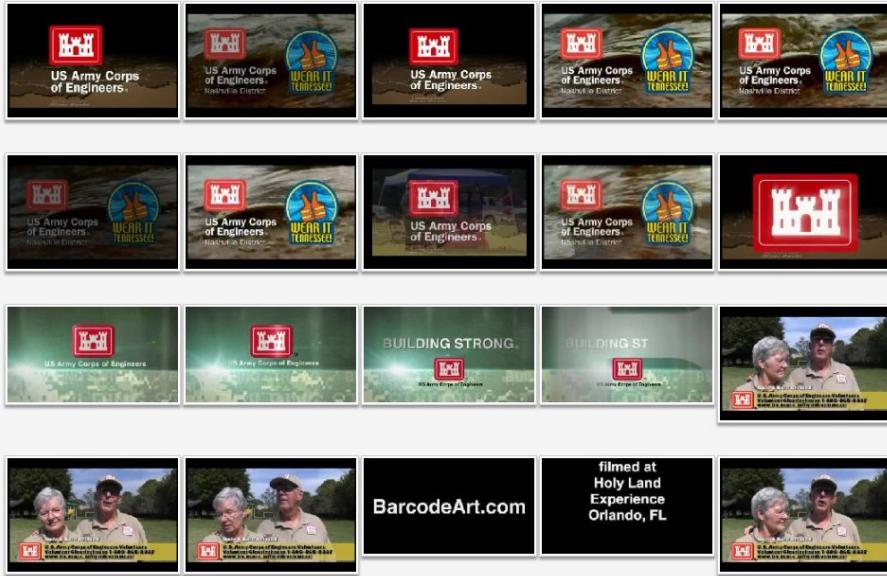
‘Red Bull’

– TRECVID 2012 INS



Instance Search – Examples

‘ US Army Corps of Engineers logo’
– TRECVID 2012 INS



‘Eiffel tower’
– TRECVID 2012 INS



Instance Search – Examples

‘ US Capitol’

– TRECVID 2012 INS



‘Obama logo’

– TRECVID 2012 INS



Pretrained classifiers

- On-the-fly is very powerful, but takes time
- Compromise between speed and accuracy
- For common queries: better use models that have been trained offline
- Cache results
- Imagenet categories, celebrities, ...



Multimedia Event detection

Short action, i.e. answer phone, hand shake



answer phone



hand shake

Multimedia Event detection

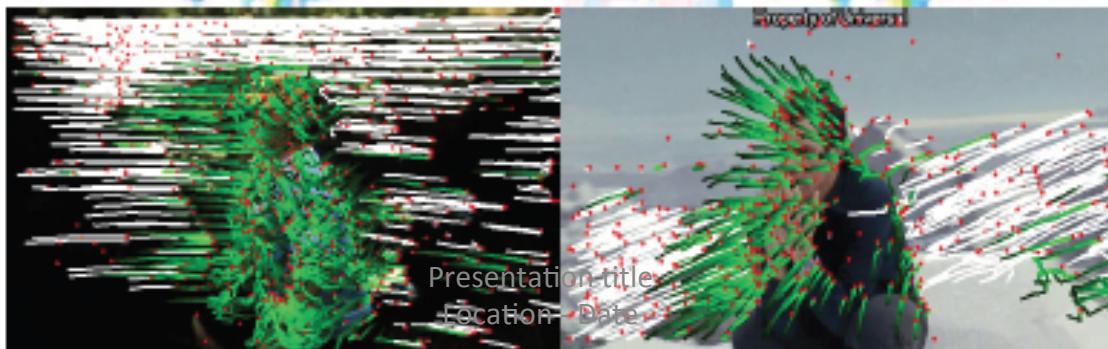
- Activities/events, i.e. birthday party, parade

Birthday party



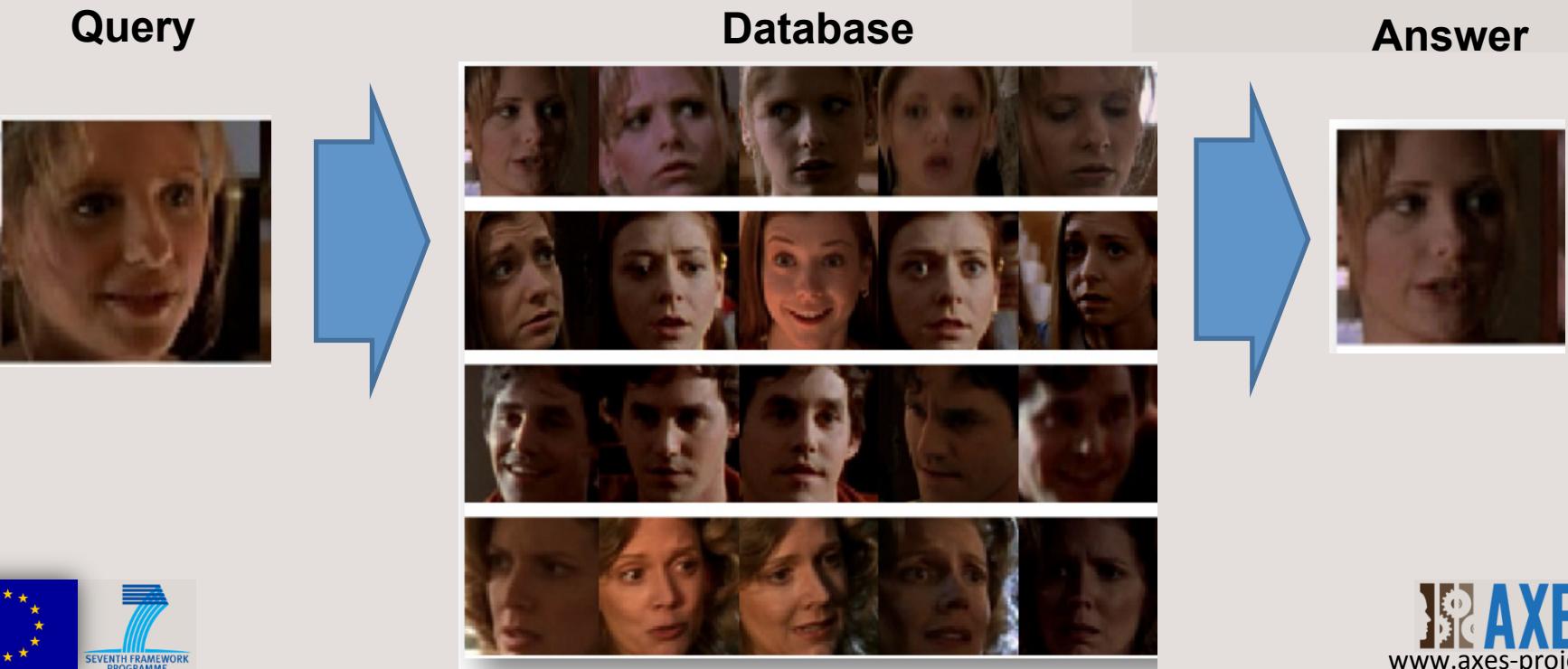
Parade





Similarity search Faces

- Face detection in query image (or user-assisted face selection)
- Landmarks detection and HOG descriptors computation
- Matching using a metric learned offline



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AXES PRO

AXES Professional Search System

(73) ESAT Webmail :: Inbox AXES AXES Professional Search System

axes.ch.bbc.co.uk/axes/pro/nisvpro/ Google

Logged as axes | Log out | Version 1.5

HOME | ABOUT | HELP

SEARCH ARCHIVE

▲ TEXT SEARCH
neushoorn
● Metadata
● Spoken words

▼ VISUAL SEARCH

▼ SIMILARITY SEARCH (0)

▼ METADATA FILTERS

▼ DATE RANGE

CLEAR FIND ►

▲ SAVED VIDEOS (0)
DROP VIDEOS HERE
Download Videos

RETRIEVED RESULTS (Found 66 segments in 7 videos. Showing 66 segments)

VIEW: THUMBNAILS | COMPACT | DETAILED | TRAINING IMAGES (0)

NIEUWS UIT DE NATUUR
1997-12-13 Unknown producer nl
Serie natuurprogramma's voor kinderen (8-9 jarigen), gepresenteerd door Bart Bosch. Deze aflevering: een special over de bedreigde neushoorn, opgenomen in Zuid-Afrika.
Matched on: metadata 0.80; speech 0.67

NIEUWS UIT DE NATUUR
1997-12-13 Unknown producer nl
Serie natuurprogramma's voor kinderen (8-9 jarigen), gepresenteerd door Bart Bosch. Deze aflevering: een special over de bedreigde neushoorn, opgenomen in Zuid-Afrika.
Matched on: metadata 0.80; speech 0.66

NIEUWS UIT DE NATUUR
1997-12-13 Unknown producer nl
Serie natuurprogramma's voor kinderen (8-9 jarigen), gepresenteerd door Bart Bosch. Deze aflevering: een special over de bedreigde neushoorn, opgenomen in Zuid-Afrika.
Matched on: metadata 0.80; speech 0.65

NIEUWS UIT DE NATUUR
1997-12-13 Unknown producer nl
Serie natuurprogramma's voor kinderen (8-9 jarigen), gepresenteerd door Bart Bosch. Deze aflevering: een special over de bedreigde neushoorn, opgenomen in Zuid-Afrika.
Matched on: metadata 0.80; speech 0.64

NIEUWS UIT DE NATUUR
1997-12-13 Unknown producer nl
Serie natuurprogramma's voor kinderen (8-9 jarigen), gepresenteerd door Bart Bosch. Deze aflevering: een special over de bedreigde neushoorn, opgenomen in Zuid-Afrika.
Matched on: metadata 0.80; speech 0.63

NIEUWS UIT DE NATUUR
1997-12-13 Unknown producer nl
Serie natuurprogramma's voor kinderen (8-9 jarigen), gepresenteerd door Bart Bosch. Deze aflevering: een special over de bedreigde neushoorn, opgenomen in Zuid-Afrika.
Matched on: metadata 0.80; speech 0.57

NIEUWS UIT DE NATUUR
1997-12-13 Unknown producer nl
Serie natuurprogramma's voor kinderen (8-9 jarigen), gepresenteerd door Bart Bosch. Deze aflevering: een special over de bedreigde neushoorn, opgenomen in Zuid-Afrika.
Matched on: metadata 0.80; speech 0.56

6.4 sec PREVIEW SHOW DETAILS
2.8 sec PREVIEW SHOW DETAILS
3.7 sec PREVIEW SHOW DETAILS
6.4 sec PREVIEW SHOW DETAILS
8.8 sec PREVIEW SHOW DETAILS
19.6 sec PREVIEW SHOW DETAILS
23.1 sec PREVIEW SHOW DETAILS

ADVANCED VIDEO SEARCH ENGINE | AXES PROFESSIONAL

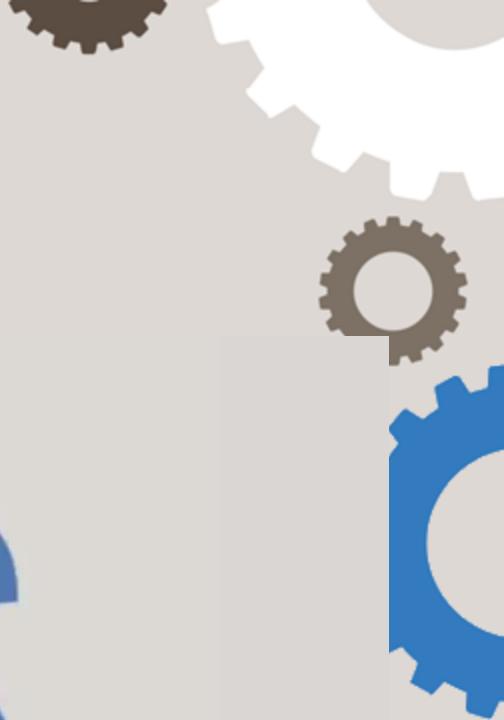
DEUTSCHE FERNSEHEN
PROGRAMME

www.axes-project.eu



AXES

ACCESS TO AUDIOVISUAL ARCHIVES



Presentation title
Location - Date

User Requirements

PRO vs. RESEARCH

- Browsing and Linking
- Tagging and Annotation
- Search trails
- Metadata export
- Customization and personalization
- Collaboration
- Usage statistics
- Thesaurus



AXES RESEARCH

AXES Research Search System

(77) ESAT Webmail :: Inbox AXES Research Search System Sportievak vzw :: sportkampen ... Contact : AXES cathedral – Google Search axes.ch.bbc.co.uk/axes/research/dwbasic/#/ robot rent

axes.ch.bbc.co.uk/axes/research/dwbasic/#/ Advanced Search Popular Videos My Collections Log Out Logged in as tuytelaars Filter Results

Recently Viewed Videos

Last viewed on: 19-11-2013
Quadriga: Der internationale Talk
USA und Europa - hat das Bündnis ausgedient?
Mehr als 60 Jahre lang standen die USA und Europa Seite an Seite. Eine feste militärische und politische Allianz während des kalten Krieges, im Kosovo und im Kampf gegen den Terror. Nun kündigt US-Präsident

Last viewed on: 18-12-2013
Berlin - Stadt-Impressionen
Berlin ist derzeit einer der angesagten Metropolen in Europa. Auch fast 20 Jahre nach dem Mauerfall ist die ehemals geteilte Stadt im ständigen Wandel. Die Unterschiede zwischen dem Ost- und Westteil bleiben spürbar und gerade dieser Prozess des fortwährenden

Last viewed on: 20-11-2013
Nach den verlorenen Landtagswahlen - Kanzlerin Me...
Im wichtigen Nordrhein-Westfalen und auch in Schleswig-Holstein werden demnächst Sozialdemokraten das Sagen haben. Wieder eine Niederlage für die Union und auch für Bundeskanzlerin Merkel. Immer häufiger verliert das Modell Schwarz-Gelb in den Bundesländern an

Last viewed on: 15-11-2013
euromaxx highlights
Jahres- und Kulturschwerpunkt In dieser Ausgabe haben

Recent Queries

Last searched on: 06-01-2014
Search “Brandenburger Tor” in Automatic search

Brandenbur... **Brandenbur...** **Tourismus** **euromaxx** **Berlin - Stadt-** **Berlin - Stadt-**

Brandenbur... **Brandenbur...** **Brandenbur...** **Brandenbur...** **Brandenbur...** **Brandenbur...**

Last searched on: 06-01-2014
Search “Brandenburg Tor” in Specific places or logos

Berlin - Stadt- **Quadriga: Der** **euromaxx** **Quadriga: Der** **Quadriga: Der**

Last searched on: 06-01-2014

www.axes-project.eu

AXES RESEARCH

AXES Research Search System

(77) ESAT Webmail :: Inbox AXES Research Search System Sportievak vzw :: sportkampen ... Contact : AXES cathedral - Google Search

axes.ch.bbc.co.uk/axes/research/dwbasic/#/search/52cb331442b47e75708f4660 robot rent

Popular Videos | My Collections | Log Out

Logged in as tuytelaars

AXES RESEARCH

Brandenburger Tor

Related Queries: Brandenburger Tor, Brandenburger Tor;

Advanced Search | Filter Results

VIEWS: Thumbnails | Detailed

Segment (200) | Program (71)

SORT BY: Relevance

Brandenburger Tor, Berlin

Date: License: Copyrighted Category: Type: Segment

<p>In der ersten Folge der Serie „Das schönste Land der Welt“ hrt &euromaxx-Reporter Michael Wigge zum **Brandenburger Tor** in Berlin - in ganz Europa als das Symbol der deutschen Einheit bekannt. Wührend der deutschen Teilung von 1961-1989 stand das **Brandenburger Tor** gleich hinter der Mauer - mitten im Sperrgebiet im Ostteil der Stadt.</p> <p>Michael Wigge lernt vor Ort das Leben der Berliner RikschaFahrer kennen: sie fahren Touristen durch das für den Verkehr gesperrte **Brandenburger Tor**.</p>

Keywords:

Spoken words: Zum einen neuen Auftrag Kreis liegt das schon das. Land der Welt die erste Lieb...

73%

 5:06

Add to Collection ▾

Brandenburger Tor, Berlin

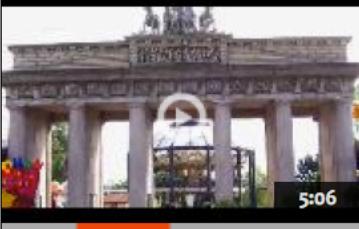
Date: License: Copyrighted Category: Type: Segment

<p>In der ersten Folge der Serie „Das schönste Land der Welt“ hrt &euromaxx-Reporter Michael Wigge zum **Brandenburger Tor** in Berlin - in ganz Europa als das Symbol der deutschen Einheit bekannt. Wührend der deutschen Teilung von 1961-1989 stand das **Brandenburger Tor** gleich hinter der Mauer - mitten im Sperrgebiet im Ostteil der Stadt.</p> <p>Michael Wigge lernt vor Ort das Leben der Berliner RikschaFahrer kennen: sie fahren Touristen durch das für den Verkehr gesperrte **Brandenburger Tor**.</p>

Keywords:

Spoken words: Ich hier verschiedene deutschen Briefmarken die deutsche Zilien zwanzig und f... Presentation title

68%

 5:06

Add to Collection ▾

Location - Date

Tourismus Nach Dem Mauerfall

www.axes-project.eu

AXES RESEARCH

AXES Research Search System

Contact : AXES quadriga - Google Search DWPlnstaller

axes.ch.bbc.co.uk/axes/research/dwbasic/#/search/52cb376642b47e756f243b8b

Popular Videos My Collections Log Out

Logged in as tuytelaars

Filter Results

Metadata

Title contains... Summary contains... Subject contains...

Keywords

Wende Mauerfall Fall Of The Berlin Wall Unification Ddr Custom:

Named Entities

Johannes Spehr Daniel Richter Boris Claudi Monika Martin Paule Hammer Custom:

Categories/Genres

Special Collections Magazine Background News News Factual Custom:

Production date

Published between 1980 and 2013

g Named Entities... Categories/Genres...

Reset filters Apply filters

VIEWS: Thumbnails | Detailed

Segment (200) | **Program (95)**

SORT BY: Relevance

euromaxx highlights Grauwasserrecycling in Jordanien Presentation title Incentiviert Energie aus Senfstroh Location - Date

www.axes-project.eu

AXES RESEARCH

AXES Research Search System

(77) ESAT Webmail :: Inbox AXES Research Search System Contact : AXES cathedral – Google Search axes.ch.bbc.co.uk/axes/research/dwbasic/#/asset//cDW_BasicPlusDemo/v336125_06_20081201_Cities_berlin_EUscreen_16-9/ robot rent

71 0 0 0 0

71 0 0 0 0

Program Information

Date: 10-10-2013 License: Copyrighted Categories: Magazine

Berlin ist derzeit einer der angesagten Metropolen in Europa. Auch fast 20 Jahre nach dem Mauerfall ist die ehemals geteilte Stadt im ständigen Wandel. Die Unterschiede zwischen dem Ost- und Westteil bleiben spürbar und gerade dieser Prozess des fortwährenden Zusammenwachsens macht Berlin einzigartig.

Keywords: DDR, consumerism, Fall of the Berlin Wall, Berlin, Geschichte des geteilten Deutschlands, lifestyle, Wende, Mauerfall, restaurant, Bürgerbeteiligung

Genres: magazine

Spoken words:

Display Keyframes

Virtual Cutter

Download Metadata

Add to Collection

Full Transcript/Subtitles

0:00:01 Berlin ist das liegen ist der Reiseziele Deutschlands der Berliner wer ist das Wahrzeichen der Stadt genau wie das Brandenburger Tor eines der meistgesuchten Touristenziele das neue Berlin rund um den Papst aber blass und die traditionelle Einkaufsmile Kurfürstendamm mit der wir uns ein echtes Kirche die im Zweiten Weltkrieg zerstört worden ist drei Komma fünf Millionen Berliner lieben ihre Stadt wie auch immer bau eine neue Sterne Koch an der ihnen Himmel.

0:00:28 Jenes Namen leben will ich war so und so in Berlin ist Wein den eine Stadt wandeln war haben wir hier sagen wir Aussichten also spricht große lagen alle aus Staaten zusammen mit dem West haben Berlin ist unglaublich multikulturelle haben legal wenn sie sagen wir bewahrt habe man da Berlin macht dann was war.

0:00:49 Polen das KaDeWe in Europa das sollte das Luxus Konfektionswaren und ihren. Auch seine zweite Heimat haben zählt zu seinen liebsten Hobby sehen kann wie die Dinge der wird die Koch was so gut wie man will und Ansprüche und ein Weihnachtsgeschenk für seine Gattin.

AXES RESEARCH@ TRECVID

My Collections Log Out
Logged in as user1
Filter Results

VIEWS: Thumbnails | Detailed

Segment (3) | Program (1)

SORT BY: Relevance

80% Q
22 V
0 D

42% Q
22 V
0 D

4% Q

Topic 9070 : a small red obelisk

Start | Pause | Finish

12:27 (x)

SEVENTH FRAMEWORK PROGRAMME

TRECVID 2013
www.axes-project.eu

EastEnders Dawn Is Finally Able To Escape May And Rob And Is Left Holding The Baby.
Date: 20-08-2013 License: Copyrighted Category: Type: Segment
Dawn is finally able to escape May and Rob and is left holding the baby. A persistent Bradley eventually wins Stacey's heart and Stella's past starts to catch up with her.
Keywords:
Spoken words: I asked Preeti to come over to match a hair style to the dress. Hiya. It looks great. Oh, I say, those aren't...

Save Video

EastEnders Dawn Is Finally Able To Escape May And Rob And Is Left Holding The Baby.
Date: 20-08-2013 License: Copyrighted Category: Type: Segment
Dawn is finally able to escape May and Rob and is left holding the baby. A persistent Bradley eventually wins Stacey's heart and Stella's past starts to catch up with her.
Keywords:
Spoken words: She has to be ready. I have another client at four o'clock!

Save Video

EastEnders Dawn Is Finally Able To Escape May And Rob And Is Left Holding The Baby.
Date: 20-08-2013 License: Copyrighted Category: Type: Segment
Dawn is finally able to escape May and Rob and is left holding the baby. A persistent Bradley eventually wins Stacey's heart and Stella's past starts to catch up with her.


Topic 9070 : a small red obelisk

Start | Pause | Finish

12:27 (x)

SEVENTH FRAMEWORK PROGRAMME

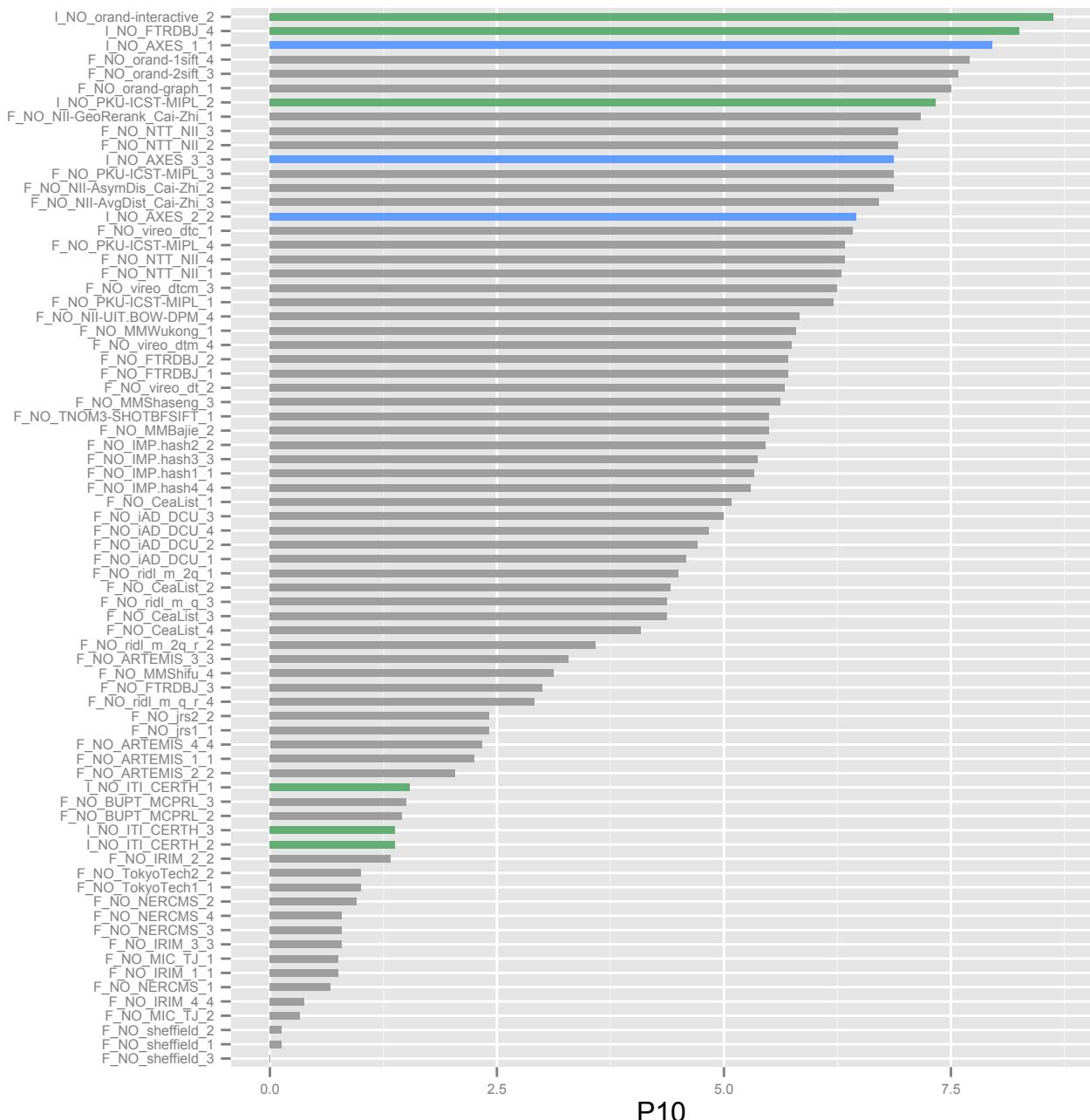
TRECVID 2013
www.axes-project.eu

TRECVID INS

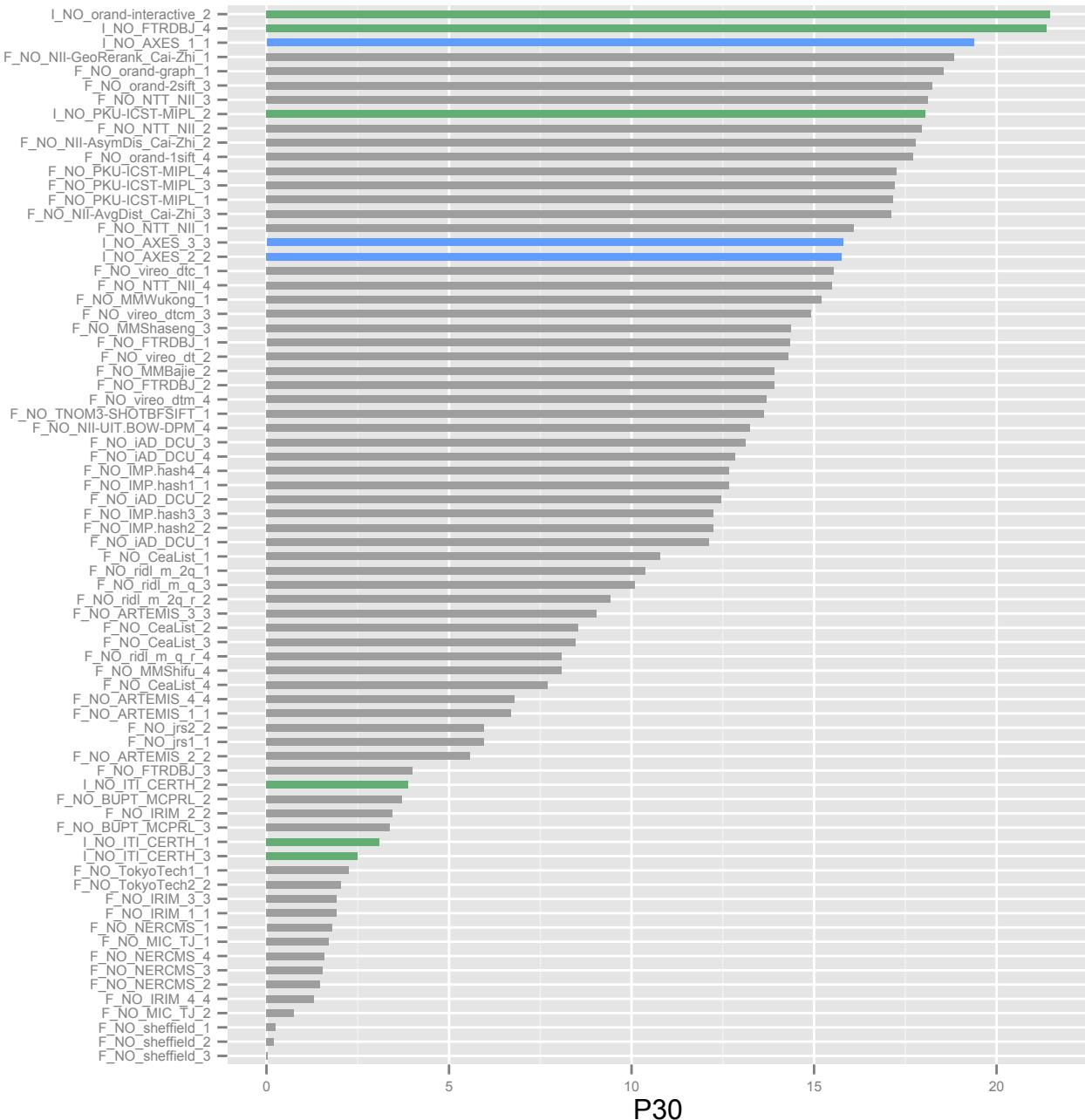
- Results
 - About average in terms of MAP
 - Good for P@10, P@30, P@100
- Issues
 - Duplicated shots from SBD



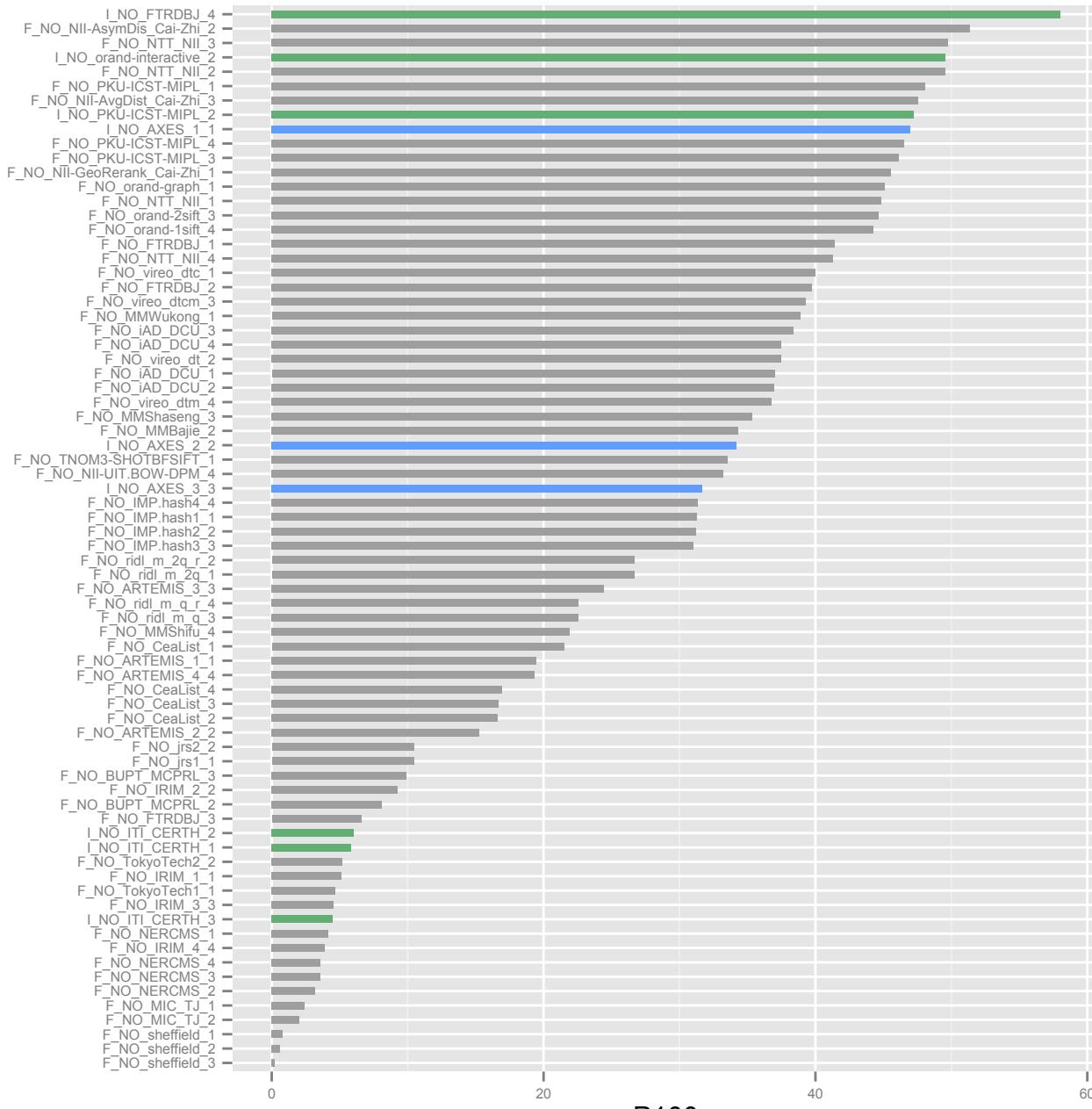
P@10



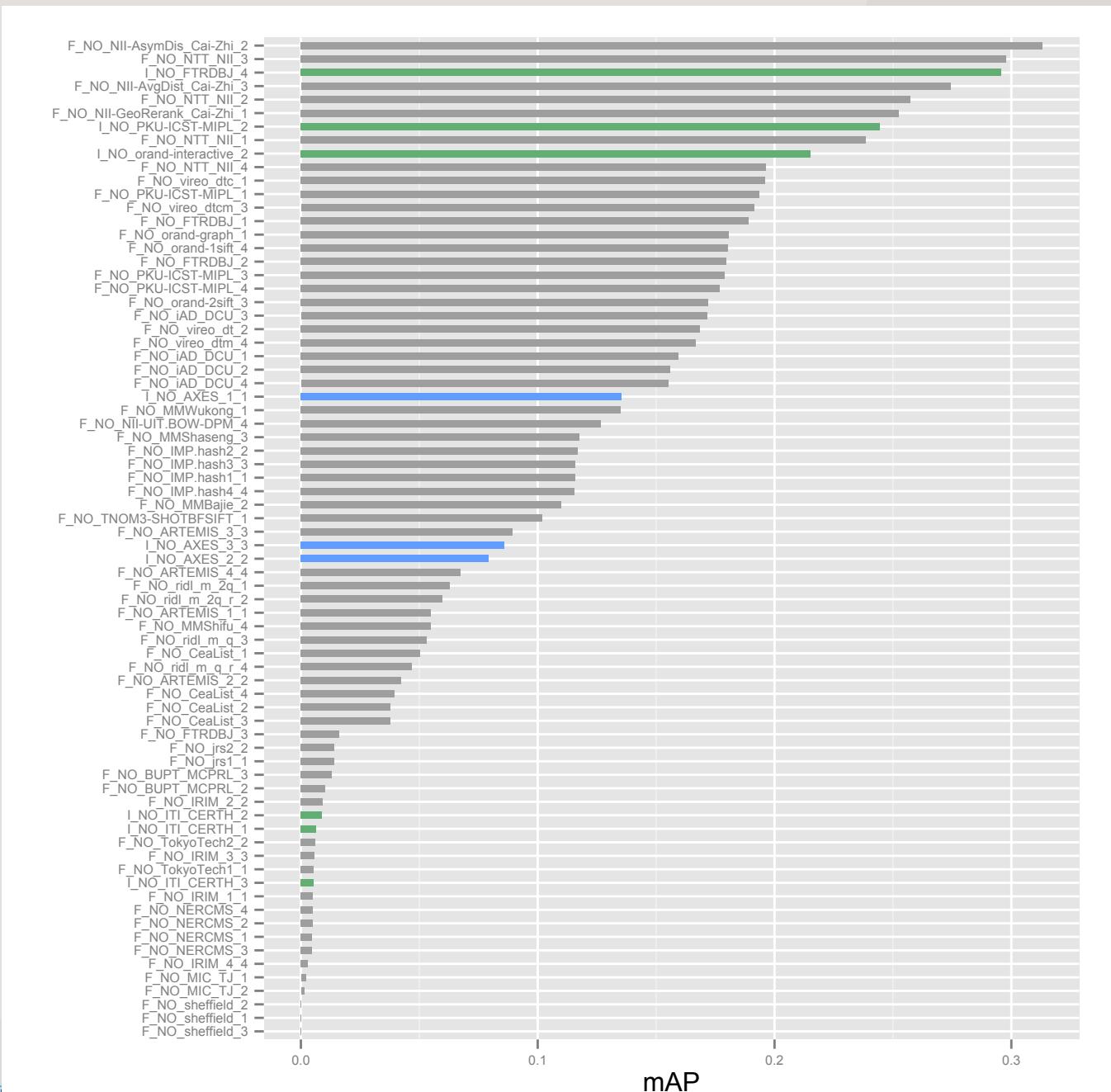
P@30



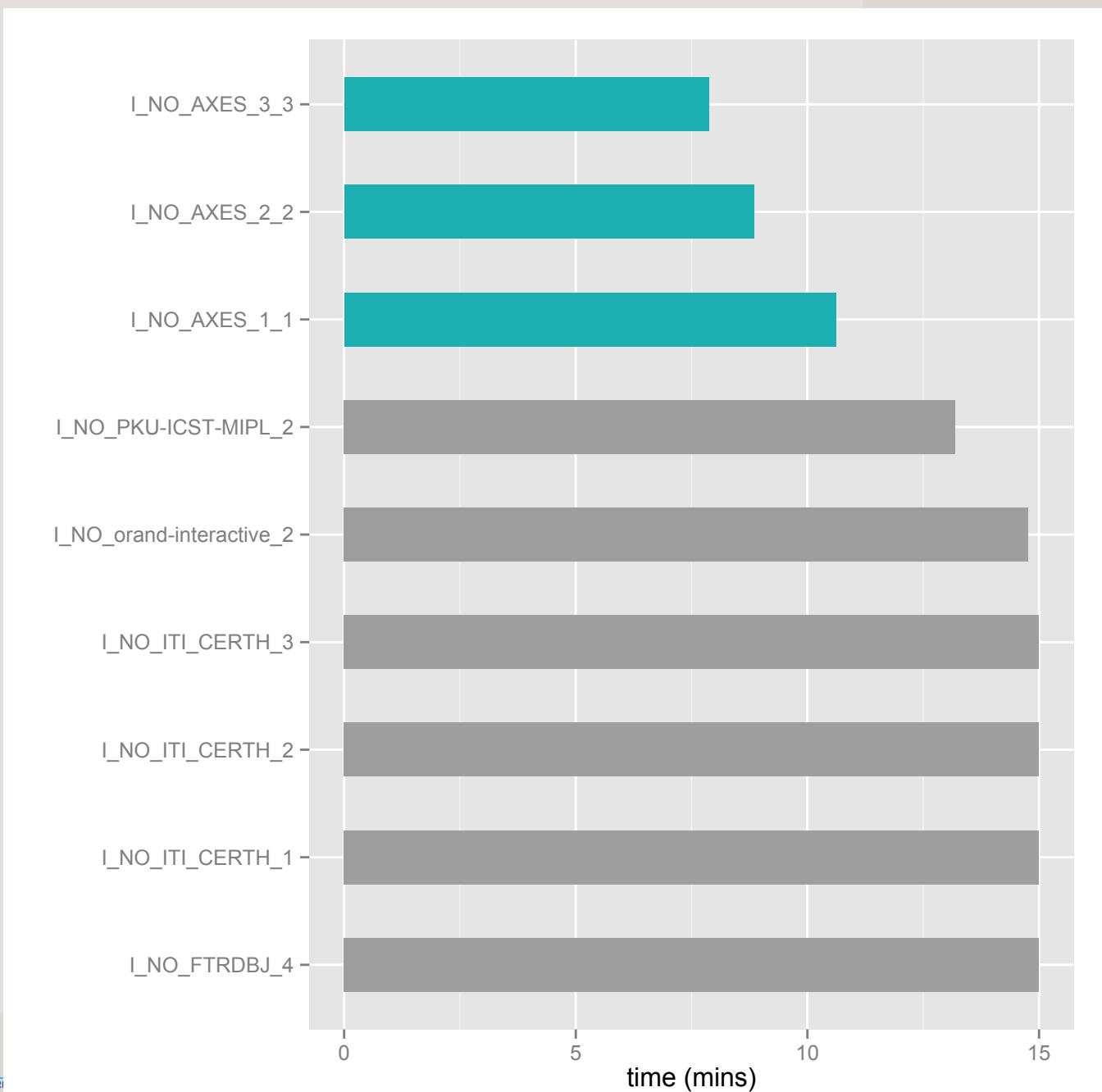
P@100



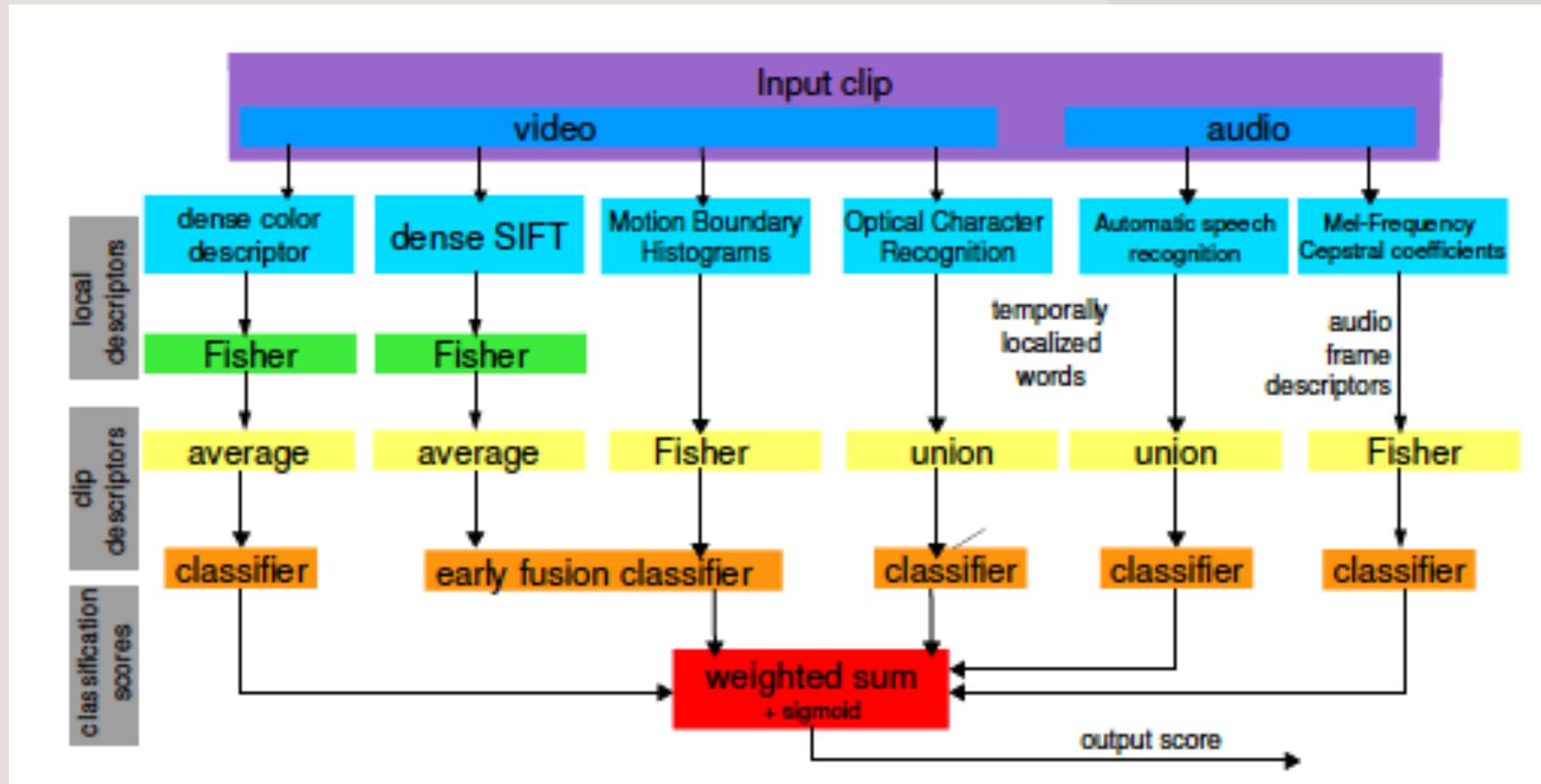
MAP



Time spent by users



AXES RESEARCH@ TRECVID



Video HVC410561



Class E013 Parkour

Combination of scores

combined score: 25.205



channel 1: deviando_256

channel 2: tsf_mb_107 tsq_mb_107 mbtc_mb_107 mbte_mb_107 st_mb_107 v_mb_107 w_mb_107

channel 3: DCR (deviando_256, tsf_mb_107, mbtc_mb_107, mbte_mb_107)

channel 4: ASR (tsq_mb_107, mbtc_mb_107, mbte_mb_107)

channel 5: color_3004_410_st

clip #	ID	fragile #	fragile ID	000000					combination	utilities	description
				1	2	3	4	5			
0	108	6	2	2.325	4.377	8.262	9.616	-0.258	0.295	Terrain_His Porous (0.71) Building (0.71) Moss_Moss_Thing (0.71) Vegetation (0.69) Wavy_Flare (0.68) Tissue_Audio (0.68)	The most relevant information for this clipper is visual. The SLOWEST sensor is deemed "best".
1	32	4	1	2.126	1.896	8.262	9.616	-0.620	0.165	Crisp (0.99) Porous (0.95) Tissue_Audio (0.93) Articulated_Hands_Thing (0.93) Snow (0.92) Surprise (0.91) Waves (0.78)	The most relevant information for this clipper is audio. The clipper needs to measure "heat", "surge" and "surprise".

TrecVid MED 2012 - results

- Combination of MBH,SIFT, audio and text recognition
- Aggregation with Fisher vector
- First in adhoc event task, second in known event task

Making sandwich – results



Rank 1



Rank 19



Rank 20

TrecVid MED 2012 - results

FlashMob gathering – results



Rank 1 (pos)



Rank 18 (pos)



Rank 19 (neg)

Overview

- The AXES project
- Audiovisual content analysis
- Demo systems:
 - AXES-PRO
 - AXES-RESEARCH
- Lessons learnt, future work



Lessons learnt

- On-the-fly model learning gives great flexibility. High potential especially when combined with offline learning / lifelong learning.
- The more data, the better.
- It's important to educate your users.
- A good user interface is important.
- Multimodal and spatio-temporal processing: easier said than done.



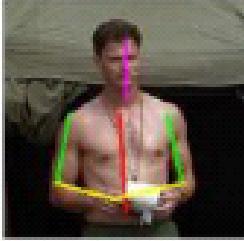
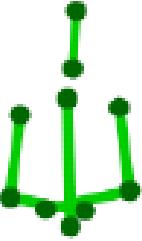
AXES HOME

What do home users want ?

- Google-like search ?
- Have fun ?

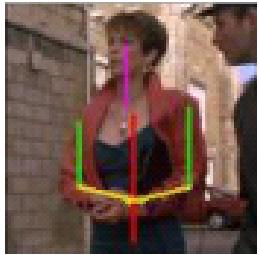


Immediate Pose Retrieval

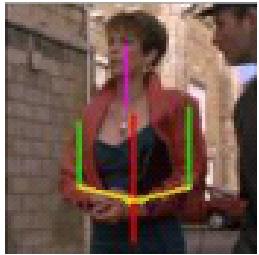


Query



- Movie: Forrest Gump
- Time: 00:40:05 - 00:40:45



- Movie: Gandhi
- Time: 01:03:23 - 01:03:32



- Movie: A fish called Wanda
- Time: 00:17:21 - 00:17:44

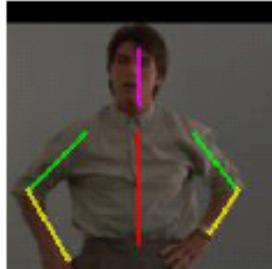


- Movie: Notting Hill
- Time: 01:36:36 - 01:36:40

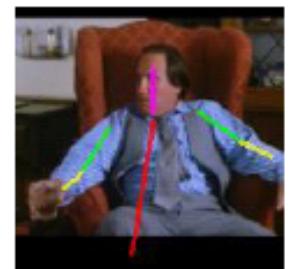
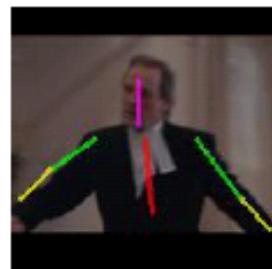
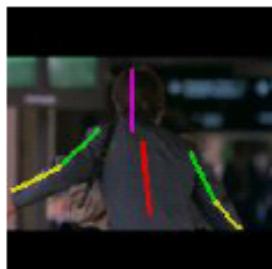
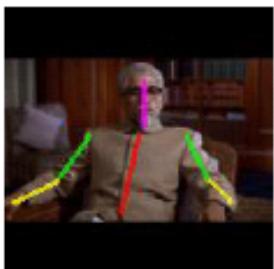
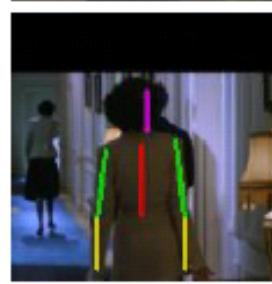
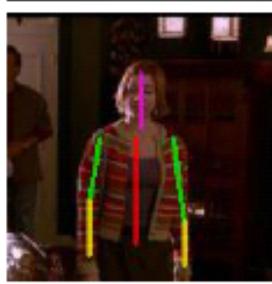
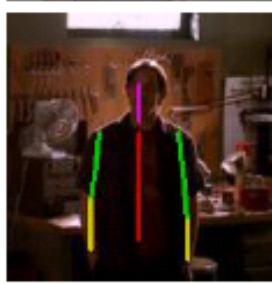
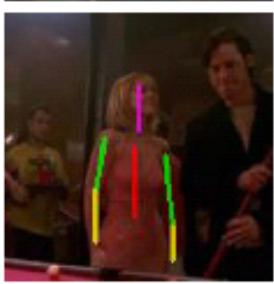
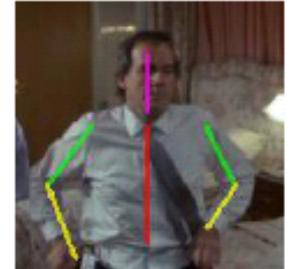
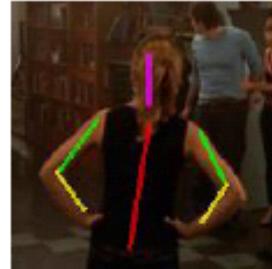
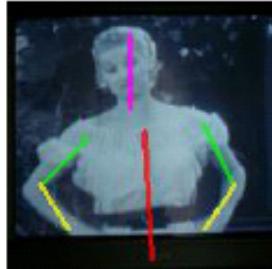
N. Jammalamadaka, A. Zisserman, M. Eichner, V. Ferrari, C. V. Jawahar
Video Retrieval by Mimicking Poses
ACM International Conference on Multimedia Retrieval, 2012

Examples

Query Pose



Top five retrievals



AXES HOME

What do home users want ?

- Google-like search ?
- Have fun ?
- Browse ?



Linking

- What are interesting links ?
- Semantics, semantics, semantics
- Not too similar, not too different



AXES HOME

What do home users want ?

- Google-like search ?
- Have fun ?
- Browse ?
- Suggest content to user based on his/her behavior ?



Questions ?

