How Computers are Reading the Picture

Andrew Ellis, Director, Public Catalogue Foundation

ARLIS/NA 43rd Annual Conference, Fort Worth

20th March 2015
Andrew Zisserman is the Professor of Computer Vision Engineering at the Department of Engineering Science, University of Oxford, where he heads the Visual Geometry Group (www.robots.ox.ac.uk/~vgg/). His research area is computer vision - automated recognition in images and videos. He has authored over 300 papers in this area, and has also co-edited and written several books.

Elliot Crowley is a research student with the Visual Geometry Group at the University of Oxford under the supervision of Professor Andrew Zisserman. He specializes in the application of Computer Vision and Machine Learning to finding objects in art automatically, and has authored several papers on this topic.
PCF Mission

To open up art in UK public collections for enjoyment, learning and research
The Paintings

- Over 210,000 paintings
- Oil, tempera, acrylic and mixed media
- Almost all publicly owned
- Not selective
- 80% not on show
- Most not photographed before

Albert Richards (1919 - 1945)
The Seven Legends: Self Portrait
Tempera on Board 74 x 56 cm
Walker Art Gallery, Liverpool
Watch a slideshow of 92 paintings by William Powell Frith

More paintings by William Powell Frith

Share this page

More paintings by William Powell Frith

Watch and listen about Frith

Elsewhere on the web

- Oxford Index - William Powell Frith
- Wikipedia - William Powell Frith
Southampton City Art Gallery

First opened in 1939 and housed in a beautiful and period, custom-designed building, Southampton City Art Gallery holds one of the finest collections of art in the south of England. Currently comprising 2,700 works and spanning 8 centuries, the collection is an outstanding educational resource that can trace the history of European art from the Renaissance to the present. The core, however, is British 20th century and contemporary art. Strong clusters of this element include Post-Impressionism (Camton Town Group), Surrealism, St Ives, and progressive contemporary (Turner Prize) from the mid-1970s.

> Read more

This location is open to the public

Civic Centre, Southampton, Hampshire, England, SO14 7LP
If you are planning a visit to see a particular painting, check with the location first. Paintings can be moved at short notice.

Contact details
Tel: 023 8083 4563
Email: Art.gallery@southampton.gov.uk
Website: http://www.southampton.gov.uk/s-leisure/artheritage/sotonartgallery/
The Monet Arriving at Onny Primary School
Grangefield Primary School, Gloucestershire, with *The Village Gossips* by Stanley Spencer
Do you know who painted this picture?

Welcome to Art Detective where anyone with specialist knowledge can help public art collections across the United Kingdom. Find out more here.

Find out how you can get involved. Click here if you represent a public art collection.
Discussions

Portraits: British 20th C ● 7

When was this portrait of W. C. Blackett painted and who was the artist?

Last comment by John Hilliard, North East England: «…»

Andrew Greg, Acting British 19th C, » 11 Aug 2014

Status

All (1)
Active (0)
Completed (0)

Groups

All (98)
British 16th and 17th C, except portraits (1)
British 18th C, except portraits (1)
British 19th C, except portraits (9)
British 20th C, except portraits (8)
Continental European before 1800 (1)
Cumbrian: Artists and Subjects (8)

Portraits: British 20th C ● 2

Which of the two portraits of Alfred Langton on Your Paintings is by Urwick, or are they both?

Last comment by Desmond Bullock

Royal Free Hospital, » 11 Aug 2014

Portraits: British 20th C ● 5

Do you know anything further about ‘A. G. Klein’ who painted Sir George Anderson Critchett?

Last comment by Martine Hopkinson

Jan Marsh, » 11 Aug 2014

Artist
“Sculpture is what you bump into when you back up to look at a painting”

Ad Reinhardt
Sculpture of the Last 1000 Years

• UK’s publicly owned sculpture heritage, held within museums and public buildings
• Public monuments and sculptures in outside spaces.
• An estimated 100,000 objects in total
The Collaboration with Oxford
The White Queen

Clips

“I am the Kingmaker’s daughter”
Episode 19
DURATION: 00:37

“All you do all day is plot revenge”
DURATION: 00:45

Meet the Characters

Meet the historical figures who feature in Philippa Gregory’s White Queen.

- Read their profiles
British School

*Elizabeth Woodville, Queen of Edward IV*  c.1500

Oil on Panel 41 x 32 cm

The Ashmolean Museum
Other online art resources

Museum websites e.g. Ashmolean, Tate, British Museum, National Gallery
Google Art project
Wikipedia
VADS
Grove art
ARTstor
Examples of other art resources

This figure rises to 62% for the male audience.
About this painting

Loading Timber at Southampton Docks
by Christopher Nevinson

Date painted: 1917
Oil on canvas, 61 x 61 cm
Collection: Southampton City Art Gallery

Where to see this painting?
Southampton City Art Gallery
Civic Centre, Southampton, Hampshire, England, SO14 7LP
If you are planning a visit to see the painting, check with the collection first. Paintings can be moved at short notice.

More on this painting
▶ Additional information
• Print a copy of this painting or order online

Art Detective
Do you have expert knowledge about this painting that could help improve our records?
Tell us what you know
Choose your favourite collection to tag

Latest tweets

Unusual but well known painting of two Elizabethan women and their children in red christening robes. #YourPaintings http://t.co/RX0gAPABw
4 days ago @Peter.Jones40

I want Joan’s shawl. That is all. #YourPaintings http://t.co/IUJ1tIq5
4 days ago @charlhastings

Does the UK have a disproportionate amount of shipping portraits, or are these everywhere? #YourPaintings http://t.co/IHTZvqBqD
4 days ago @charlhastings

River Arno and Ponte Vecchio in Florence, by nephew (and pupil) of Canaletto, Bernardo Bellotto. #YourPaintings http://t.co/1sm5T1Wwc8
5 days ago @Peter.Jones40

Summer fruit: Mulberry leaves and peaches #YourPaintings http://t.co/Ko5LbiDDQd
5 days ago @charlhastings

About the project

More about tagging

See the UK’s oil painting collection

More about the Public Catalogue Foundation

Project progress

9,583 Taggers
4,347,479 Tags
188,644 Being tagged

23,237 Tagged
211,861 Paintings

Top 10 taggers

<table>
<thead>
<tr>
<th>Position</th>
<th>Last Week</th>
<th>Screen Name</th>
<th>Paintings</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>c_hastings</td>
<td>1179</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>Tuppence</td>
<td>685</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Daisydaisydaisy</td>
<td>644</td>
<td></td>
</tr>
</tbody>
</table>
Girl with Violin
by Edward Le Bas

Date painted: c.1940
Oil on card, 64.5 x 54 cm
Collection: Arts Council Collection

Where to see this painting?
Arts Council Collection, Southbank Centre
Belvedere Road, London, Greater London, England, SE1 8XX
If you are planning a visit to see this painting, check with the collection first. Paintings can be moved at short notice.

More on this painting
- Additional information
- Print a copy of this painting

Art Detective
Do you have expert knowledge about this painting that could help improve our records?
Tell us what you know

More paintings by Edward Le Bas
- The Lighthouse, Rye
- The Band in Hyde Park
- Dinner at the Garrick

Help us tag the Nation’s Art Collection
Visual Geometry Group
Department of Engineering Science, University of Oxford

Research

Visual Search of BBC News
On-the-fly retrieval of object categories, instances and faces using a textual keyword.

Video Google Demo
Retrieve objects or scenes in a movie with the ease, speed and accuracy with which Google retrieves web pages containing particular words.

Visual Search of Paintings
Search a large dataset of paintings on the fly for a given object category.

Deep Features Evaluation
Evaluation of deep convolutional features for image classification.

Upper Body Pose Estimation and Tracking
Fast and accurate upper body pose estimation over long video sequences using a random forest framework with pose structured output.

Automatic Annotation of Greek Vases
A method allowing automatic detection of gods and animals in a large dataset of Greek vases.

Oxford Building Search Demo
Search for specific objects in extremely large datasets of images using efficient methods.

Video Google Faces Demo
Retrieve shots containing particular people/actors in video using an imaged face as the query.

Reading Text in the Wild
Localising and recognising text in natural images, allowing large scale annotation and search for text in images.

Encoding Methods Evaluation
Evaluation of shallow feature encoding methods for image classification.

Sculpture Retrieval and Identification
A retrieval-based method for automatically determining the title and sculptor of an imaged sculpture.

Descriptor Learning Using Convex Optimisation
Learn feature descriptors using convex formulations for keypoint matching and object instance retrieval.
The Oxford Team at the Department of Engineering Science

Andrew Zisserman is the Professor of Computer Vision Engineering at the Department of Engineering Science, University of Oxford, where he heads the Visual Geometry Group (www.robots.ox.ac.uk/~vgg/). His research area is computer vision - automated recognition in images and videos. He has authored over 300 papers in this area, and has also co-edited and written several books.

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The Challenge

- At the start of the project c.9,000 of the paintings in Your Paintings had been tagged by the public
- Oxford sought to tag the remaining paintings
Method One – Learn from the Human Taggers
Considered the most frequently occurring tags

<table>
<thead>
<tr>
<th>Word</th>
<th>Number of Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man</td>
<td>3832</td>
</tr>
<tr>
<td>Sky</td>
<td>3324</td>
</tr>
<tr>
<td>Tree</td>
<td>3107</td>
</tr>
<tr>
<td>Cloud</td>
<td>2607</td>
</tr>
<tr>
<td>Woman</td>
<td>2356</td>
</tr>
<tr>
<td>Portrait</td>
<td>1708</td>
</tr>
<tr>
<td>House</td>
<td>1595</td>
</tr>
<tr>
<td>Building</td>
<td>1494</td>
</tr>
<tr>
<td>People</td>
<td>1388</td>
</tr>
<tr>
<td>Sea</td>
<td>1211</td>
</tr>
<tr>
<td>Window</td>
<td>1146</td>
</tr>
<tr>
<td>Hill</td>
<td>1129</td>
</tr>
<tr>
<td>Landscape</td>
<td>1127</td>
</tr>
<tr>
<td>Boat</td>
<td>1114</td>
</tr>
<tr>
<td>Chair</td>
<td>1011</td>
</tr>
<tr>
<td>Grass</td>
<td>1006</td>
</tr>
<tr>
<td>Blue</td>
<td>998</td>
</tr>
<tr>
<td>Hat</td>
<td>990</td>
</tr>
<tr>
<td>Water</td>
<td>977</td>
</tr>
<tr>
<td>Flower</td>
<td>953</td>
</tr>
</tbody>
</table>
Learning a classifier

For a given tag, learn both:
(i) what is common between paintings with this tag
(ii) What differentiates them from paintings without this tag
New Tags

This learning was applied to untagged paintings to produce a ranked list of paintings potentially containing that tag

man
Results

• Over 250 Taggers took part, some verifying as many as 50,000 tags

• 200 different tags (i.e. cloud, train etc) were spread over 93,000 different paintings

• In total 250,000 new tags for PCF paintings were confirmed as correct by the Taggers
## Tags on the Up

<table>
<thead>
<tr>
<th>Subject</th>
<th>Start of Project</th>
<th>After Stage 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>1,413</td>
<td>12,385</td>
</tr>
<tr>
<td>Boat</td>
<td>973</td>
<td>8,825</td>
</tr>
<tr>
<td>Man</td>
<td>4,039</td>
<td>9,470</td>
</tr>
<tr>
<td>Hair</td>
<td>1,028</td>
<td>5,853</td>
</tr>
<tr>
<td>Suit</td>
<td>566</td>
<td>3,883</td>
</tr>
<tr>
<td>Tie</td>
<td>593</td>
<td>2,729</td>
</tr>
<tr>
<td>Button</td>
<td>366</td>
<td>1,889</td>
</tr>
</tbody>
</table>
Example Tag - cow
Example Tag - earring
Example Tag - spire
Method Two—Learn from Google
Results

• 12,000 verified tags
• Across 47 challenging categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Confirmed Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>500</td>
</tr>
<tr>
<td>Food</td>
<td>346</td>
</tr>
<tr>
<td>Headdress</td>
<td>253</td>
</tr>
<tr>
<td>Destruction</td>
<td>201</td>
</tr>
<tr>
<td>Words</td>
<td>120</td>
</tr>
<tr>
<td>Crucifixion</td>
<td>109</td>
</tr>
<tr>
<td>Butterfly</td>
<td>47</td>
</tr>
</tbody>
</table>
New tags: Destruction
New tags: Ice
Method Three—Learn from Google on the Fly
How it Works

• The user provides a text query, e.g. dog
• A Google Image Search for this query is performed and the images are downloaded
• From these, Oxford learns a visual classifier to then query Your Paintings
How it works

dog → photographs → YOUR PAINTINGS > 200,000 Paintings → paintings
Live Demo

Oxford Painting Retrieval

Why not try? abstract beard boat dog flower house horse moustache train woman

http://varro2.robots.ox.ac.uk:8085
WORD ENTERED: BEARD

Google Images

Retrieved Paintings
WORD ENTERED: BRIDGE

Google Images

Retrieved Paintings
Challenges

• Integrating Oxford tags back into PCF database
• Broadening the range of tags/classifiers to beyond the first 250 objects and easy concepts
• Integrating Tagger into a new model for the project
Other Work with Oxford
Your Art
-The New Model
PCF Painting Database

3,000 Participating Collections

Public Interfaces

BBC Your Paintings
PCF Tagger
PCF Art Detective
PCF Website

PCF Only Interface
PCF Your Art Database

Contains all art historical data, copyright permissions, contact information, tags, OUP data, images.

YOUR ART WEBSITE

BBC
CURATED YOUR ART CONTENT

Traffic

YOUR ART WEBSITE

PCF Your Art Database

Contains all art historical data, copyright permissions, contact information, tags, OUP data, images.

Public Interfaces

Collections Interface

Partner Interface

PROJECT PARTNER PORTAL
To share content with BBC and other project partners through a suite of APIs

COLLECTIONS PORTAL

PUBLIC INTERFACES

Traffic

Data

Licence Images
Update Records
Upload Images
Art Detective
Receive Tags
Analytics (PO)
Commercial (PO)

Search
Download Images
Conclusions

• Your Art: A platform for showcasing the UK’s public art collections

• Importance of subject matter in drawing in broader audiences.

• Partnership with Oxford already producing excellent results

• The long tail of paintings that are rarely seen will become better known
Web Links

thepcf.org.uk

bbc.co.uk/yourpaintings

robots.ox.ac.uk/~vgg/
Mario Rossi (b. 1958)
_The End/Untitled_ (part of a series), 1996-2000
Arts Council Collection