

# MultiMatch – Multilingual/Multimedia Access to Cultural Heritage\*

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## Abstract

*Cultural heritage content is everywhere on the web, in traditional environments such as libraries, museums, galleries and audiovisual archives, but also in popular magazines and newspapers, in multiple languages and multiple media. MultiMatch is a 30 month specific targeted research project under the Sixth Framework Programme, supported by the unit for Content, Learning and Cultural Heritage (Digicult) of the Information Society DG. MultiMatch plans to develop a multilingual search engine designed specifically for the access, organization and personalized presentation of cultural heritage information. This paper provides an overview of the project goals and describes the preliminary results.*

## 1. Introduction

Europe's vast collections of unique and exciting cultural content are an important asset of our society. On the web, cultural heritage (CH) content is everywhere, in traditional environments such as libraries, museums, galleries and audiovisual archives, but also reviews in popular magazines and newspapers, in multiple languages and multiple media. Moreover, many consumers have now become contributors to information about CH objects through weblogs ("blogs") and discussion boards [1]. CH objects on the web are no longer isolated objects, but situated, richly connected enti-

ties, equipped with very heterogeneous metadata, and with information from a broad spectrum of sources, some with authoritative views and some with highly personal opinions.

What means do users have to access these complex CH objects? How can they explore and interact with CH content in ways that do justice to the richness of the objects without being overwhelmed? Currently, users interested in accessing CH content - be it for educational, touristic, or economic reasons - are left to discover, interpret, and aggregate material of interest themselves. Rose and Levinson [14] show that over 60% of today's web searches are so-called informational queries, i.e. queries that essentially ask for multiple perspectives from multiples sources. Such queries are not necessarily easy to formulate.

The cultural heritage search and navigation facilities that we envisage would cater for these information needs by presenting users with a composite picture of complex CH objects. For instance, in reply to a user's request for information on Van Gogh, the MultiMatch engine could present certified information on Van Gogh from multiple museums around Europe, in multiple languages; it could complement this with pointers to Van Gogh's contemporaries, with links to exhibitions on Van Gogh, to reviews of these exhibitions, to blog entries by visitors to these exhibitions, and to background information taken from online resources or dedicated sites.

The need to provide information seeking users in the CH domain with this kind of result, poses a number of scientific challenges for information retrieval research in areas as diverse as web crawling, multilingual access, multimedia access, semantic processing, and presentation design. The MultiMatch research agenda aims at making significant developments in each of these areas in order to arrive at a proof-of-concept implementation of a user-centered search and navigation engine for cultural heritage content.

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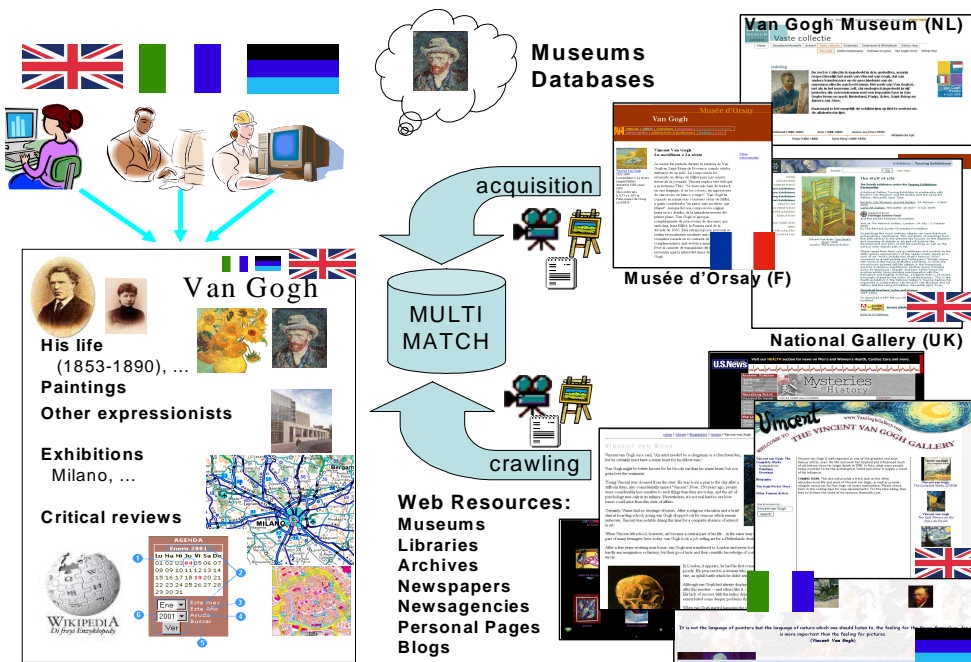


Figure 1. Overview of the MultiMatch integrated system.

This paper is intended as an introduction to the project. It briefly outlines the main research challenges being addressed and gives a broad view of the end user functionality to be provided by the MultiMatch search engine. The following section provides an overview of the activities and expected results, while Sections 3 and 4 illustrate the functionality to be offered and describe how this has been defined through a deep analysis of user requirements. Section 5 give some details on the project duration and the Consortium.

## 2. The project Structure

The concepts underlying the system are shown in Figure 1. On the left-hand side of the figure, we show users querying the system in different languages for a range of information on the Dutch artist Vincent van Gogh, including critical analysis, biographies, details of exhibitions. The system displays the information retrieved in an integrated fashion, and in a format determined by the particular user profile. On the right-hand side, we show possible sources of this information and the ways in which it can be acquired.

The project aims at developing a system prototype that can be demonstrated for at least four languages: Dutch, English, Italian and Spanish, and extendible to others. Figure 2 gives an idea of the workflow for the system development. The R&D work is organized around three activities:

- *User-oriented research* activities will focus on

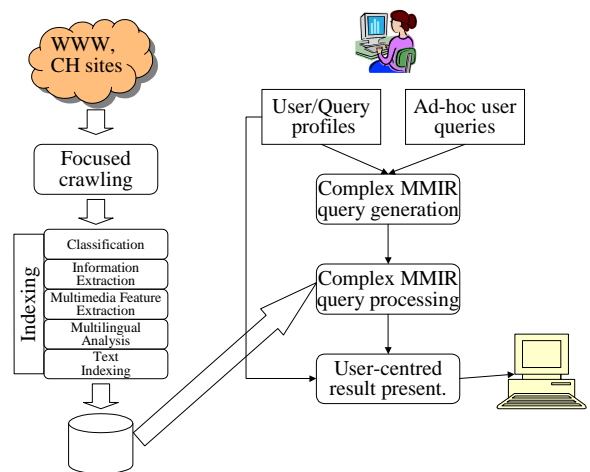


Figure 2. Workflow for the MultiMatch search engine development.

analysing the user requirements, defining the necessary system functionality, selecting and preparing content for system development, studying the ontologies used in the CH domain and the semantic encoding to be adopted by the system.

- *System-oriented research* activities include the study and development of software components for the acquisition, indexing, classification, retrieval and presentation of multilingual CH information in diverse and mixed media and their integration in the system prototypes.
- *Validation* activities will include evaluation of the system and its components. User groups composed of CH institutions and CH consumers will be formed to test the system and provide feedback.

## 2.1. Expected Results

The MultiMatch search engine will be able to:

- identify relevant material via an in-depth crawling of selected CH institutions, accepting and processing any semantic web encoding of the information retrieved;
- crawl the Internet to identify websites with CH information, locating relevant texts, images and videos, regardless of the source and target languages used to write the query and/or describe the results;
- automatically classify the results on the basis of a document's content, its metadata, its context, and on the occurrence of relevant CH concepts;
- automatically extract relevant information which will then be used to create cross-links between related material, such as the biography of an artist, exhibitions of his/her work, critical analysis, etc.;
- organise and further analyse the material crawled to serve focused queries generated from information needs formulated by the user;
- interact with the user to obtain a more specific definition of initial information requirements;
- the search results will be organized in an integrated, user-friendly manner, allowing users to access and exploit the information retrieved regardless of language barriers.

The achievement of these objectives implies a significant research effort in the general field of multilingual/multimedia information access and retrieval, and in particular in the following areas:

### Focused search engine

In its simplest form, a vertical search engine, i.e., one that caters for domain-specific searches, simply filters a subset of the web believed to be relevant to a topic. In a more useful form, a vertical search engine is able to extract information from web pages, allowing for more sophisticated query interfaces and presentation of results adapted to the task.

MultiMatch aims to take a significant leap forward from today's vertical search engines, by offering "complex object retrieval" through a combination of focused crawling and semantic enrichment that exploits the vast amounts of meta-data available in the cultural heritage domain, presenting both certified and non-certified information together (while clearly distinguishing one from the other). MultiMatch intends to build on advances in web retrieval over the past decade [6].

The MultiMatch project fits into the category of advanced, domain-specific search engines, with some salient features: i) it will be the first search engine combining automatic classification and extraction techniques with semantic web compliant encoding standards; ii) it will consider complex user profiles and search scenarios; iii) it will be able search across language boundaries and across different media.

### Multilingual/multimedia indexing

Instead of returning documents in isolation, MultiMatch will provide complex search results that put documents of various media types into context. For the indexing-end of MultiMatch, complex object retrieval generates special challenges. First, documents of various media types (text, audio, image, video, or mixed-content) and accompanying metadata are being indexed. Existing generic standards such as MPEG-7 cater for such data models by incorporating multimedia content and metadata in a single semi-structured document. The indexing strategies used must also recognise and cater for multilingual content

To start the indexing process CH information is being gathered. Particular Internet domains or subdomains are being spidered using a state-of-the-art crawler [9, 12] and, in parallel, where supported by the CH institution, the engine interfaces with information sources using open standards [3, 2]. CH information is also being gathered from the Web at large, employing existing focused crawling techniques specifically targeting cultural heritage information [6, 5].

### Information extraction and classification

MultiMatch will allow users to interpret the wealth of CH information by presenting objects not as isolated individual items, but as situated, richly connected entities. A range of classifications, as well as various links to reviews, experience reports, and general background knowl-

edge, will be provided. Documents will be classified on the basis of diverse dimensions, such as topical, geographical, and temporal. Although rooted in proven technology [7], MultiMatch will venture here into unexplored terrain. For example, documents of multiple media will be classified with respect to genre (review, experience report, background knowledge).

MultiMatch will use large scale information extraction from documents to identify entities and their relations in large Web corpora [4, 8].

### **Multilingual/multimedia information retrieval**

For many years information retrieval research concentrated primarily on English language text documents. However, recent years have seen a significant increase in research activity extension to information retrieval techniques for multimedia and multilingual document collections. Unfortunately, so far, there has been little transfer of research advances to real world applications. MultiMatch aims at bridging this gap.

Multimedia data can be classified according to its constituent media streams: audio, visual and textual. Research in audio retrieval has largely been concentrated in spoken document retrieval (SDR), where the key challenge is accurate automatic content recognition. Research in visual information retrieval (VIR) for images and video data streams has similarly been underway for over 10 years. Problems of VIR relate to both recognition of visual content and the definition of visual content for IR.

Multilingual information retrieval (MLIR) has also become an established area of research in recent years. MLIR focuses on the problem of using a request in one language to retrieve documents from a collection in multiple different languages. MultiMatch is developing components for both document and query translation and procedures for matching one against the other. Much effort will be dedicated to the building of domain-specific multilingual resources catering for the terminology adopted in the CH domain [11].

A major challenge will be to merge results from queries on language-dependent (text, speech) and language-independent material (video, image).

### **User-centred interaction**

Although there has been huge progress, content-based information retrieval (e.g. video and image retrieval by visual content) still faces significant barriers when attempting to create truly effective and comprehensive retrieval with respect to the user's needs. Users look mainly for concepts (e.g. individuals, facts, places) and far less for features (e.g. mountains, sunset, clouds). A "semantic gap" exists: human beings intrinsically interpret images depending on a subjective viewpoint while computers remain at the most objective and elementary level. To bridge the seman-

tic gap, human intervention is still needed to add high-level features (i.e. metadata) [15]. However, recent advances in the areas of information retrieval and information extraction make it possible to automatically associate concepts to objects when text is available. The need for human intervention to annotate material is thus reduced. The MultiMatch user interface will integrate automatic techniques for low level feature extraction and automatic concept classification. Structures for browsing will be created on the basis of both elementary (e.g. dogs, mountains, clouds) and abstract (e.g. all the artworks of a painter) features, allowing users to explore content or search results following multiple facets. A key research problem for MultiMatch will be enabling the user to adequately formulate their query using the language of their choice and specify both low-level and high-level multimedia feature [13].

## **3. Understanding User Requirements**

A good understanding of user requirements is crucial in order to define the system functionalities. The user requirements analysis is based both on previous experience acquired by the Cultural Heritage institutions participating in the project and also on accepted theory in this area. The goal has been to identify users and their needs within a predefined and specific context and map, where possible, their requirements to those features which should be offered by MultiMatch. The user requirements study has been performed examining data from a number of sources. Interviews in isolation were not sufficient to be able to build a complete picture as users tend to formulate their description of their requirements on the basis of the tools they know. We thus supported the interviews with a set of imaginary but potentially realizable scenarios together with a vision document representing the functionality that should be included in the proposed system in order to give our users a larger picture [10]. Although this study mainly focussed on users of cultural heritage information for professional purposes, we have also studied log data of user queries to a general purpose search engine in order to understand the types of CH query formulated by the general user.

Different classes of user (from the educational, tourism, and cultural heritage professional sectors) have been identified, together with an analysis of the tasks they perform and the scenarios in which MultiMatch can be expected to operate for these users. This study mainly addresses the needs of users that target cultural heritage information for their professional needs. The motivation is that this kind of user already has well-identified requirements and has had experience in trying to satisfy them with the currently available tools. The analysis has aimed at addressing questions such as what users in the cultural heritage domain typically do on a day-to-day basis (i.e. their work tasks), what type of infor-

mation they need, and how they look for it (i.e. their search behavior), what would these users require from an information system like MultiMatch to enable them to carry out their activities more effectively (i.e. functionality), and how would these users expect MultiMatch to respond to their search requests (i.e. presentation).

In a first stage, we identified a very large set of requirements. We then analyzed this set in order to identify in the order: (1) the most requested (considered as high-priority); (2) those requirements that best matched the previously declared project objectives and vision. Summarizing briefly, we can say that the main findings were that:

- CH professionals do use the internet widely and as part of their daily work routine but they currently depend largely on generic search engines to find the information they need
- they want to query using natural language and familiar Boolean operators
- they would like full capabilities for multimedia retrieval (i.e. images and video as well as text) but, in most cases, are only accustomed to executing text searches
- their main focus appears to be on works of art and their creators, with all associated information, such as critical reviews, information on exhibitions, different versions of same document
- they tend to be frustrated by the volumes of information available on the same subject and would find information filtering, clustering and aggregation functionalities very useful
- they demand high precision of results and need to know the source and level of authority
- they need to be able to save both queries and results for future processing and reuse
- they tend to restrict their searches to their own language plus English, thus missing information only available in other languages
- if multilingual search was available, they would like to have the results associated with descriptive snippets in their own language (preferably) or English (optionally).

#### 4. System Functionality

According to the user requirements collected during the first stage of the project, the main functionality that MultiMatch is expected to offer is powerful and flexible access to



**Figure 3. Cultural object created using title plus snippet plus extra information such as the page source**

Cultural Heritage information available on-line, on the Web as well as in specialized digital libraries or portals. The main user needs are related to (i) the quality of retrieved items – they must be relevant to the user request, and provided by *certified* sources – (ii) easy formulation of the user request, and (iii) easy visualization and aggregation of retrieved items.

A preliminary discussion aimed at defining the minimal unit of information that can be retrieved and delivered to the user: this unit of information is referred as a "**cultural object (CO)**". This is an information unit which refers to any item of society's collective memory including print (books, journals, newspapers), photographs, museum objects, archival documents, and audiovisual material. This information item can be displayed in different ways, such as:

- Simple title plus snippet-based description (possibly mixed with images and/or video and/or metadata).
- More complex structures which present a set of data related to a specific cultural heritage item such as a writer, a painter, an artwork and so on.

Figures 3 and 4 show two different possible conceptualisations of cultural objects in MultiMatch. Figure 3 shows a typical title plus snippet cultural object (with some extra information such as the source category) which links with a web page about the works of Van Gogh (note that in this case the cultural object has been rendered without any image), while Figure 4 shows how a more detailed cultural object for Van Gogh could be created from the MultiMatch ontology which is being constructed.

The MultiMatch Search Engine will enable the user to retrieve cultural objects through different modalities:

- The simplest one is a traditional *free text* search. This search mode is similar to that provided by general purpose search engines, such as Google, with the differ-



Name: Vincent Van Gogh  
Birth: 1853  
Death: 1890  
Country: Holland  
Category: Painter

t

**Figure 4. Cultural object created using extracted metadata**

ence that MultiMatch is expected to provide more precise results – since information is acquired from selected sources containing Cultural Heritage data – and with support for multilingual searches. This means that the user can formulate queries in a given language and retrieve results in one or all languages covered by the prototype (according to his/her preferences).

- Metadata based searches. The user will select one of the available indexes built for a specific metadata field – initially only *creators* and *creations* – and can specify the value of the metadata field (e.g. the *creator's name*) plus, possible additional terms.
- A browsing capability will allow users to navigate the MultiMatch collection using, among others, a web directory-like structure based on the MultiMatch ontology.

Finally, MultiMatch will support multimedia searches, based on similarity matching and on automatic information extraction techniques.

From the results of the expert users survey [10] we can conclude that, on average, CH professionals tend to classify searches for information about creators (authors, artists, sculptors, composers, etc.) and creations (works of art and masterpieces) as their most common search tasks. Therefore, in MultiMatch we have initially decided to focus on two types of specialized searches for creators and creations, although specialized searches focused on other relevant categories will also be considered. We also propose a specialized cultural heritage site search that can be understood as an extension to the initial creators and creations searches.

#### 4.1. Search Interaction Levels in MultiMatch

A key objective is to provide a system that can be easily adapted to different user needs. For this reason, MultiMatch searches can be made at three main levels of interaction:

- Default search mode

- Specialised search mode
- Composite search mode

The simplest search mode is the *default* MultiMatch search level. This is provided for generic users, with a limited knowledge of MultiMatch system capabilities, or with very general search needs. In this case, no assumption is made on the user query, and MultiMatch retrieves information from all indexed material. In this way, given a general query, MultiMatch will retrieve all the cultural objects, web pages and multimedia content that best suit the query. Merging, ranking and classification of these results will be also performed by the system.

The default search level must be understood as a way for the users to express their search needs when they are not looking for information about a specific cultural item (such as a creator or a creation) or when they do not want information in a specific media but want to retrieve all relevant information related to their free text queries.

This interaction level, thus, involves the retrieval of not only cultural objects (i.e. creators and creations) but also web pages, images and videos related to the query. For instance, the query "flowers" should retrieve all cultural objects related with to this topic, such as "the sunflowers" or "waterlily" artwork, but also a ranked list of web pages, a list of relevant news or a list of images and videos.

Figure 5 illustrates the behavior for general searches using the example presented above. The user types in flowers and retrieves web pages (such as the announcement of a temporary exhibition at the Tate Modern entitled Flowers and questions), creators typically associated with flowers (such as Van Gogh), and creations (such as Sunflowers by Van Gogh).

Users with a more precise knowledge of MultiMatch system functionality, and with specific search needs, may use one of the *specialized* interaction levels available. These allow the user to query MultiMatch specific search services (for instance, video search, image search, etc.) and retrieve all the relevant information available via the selected search service. In this way, MultiMatch will include standalone image, video and metadata-based searches, each with its own search fields, display and refinement options. It will also include a set of browsing capabilities to explore MultiMatch content.

The specialized interaction level will allow the user to use specific query services, such as metadata-based search, image and video search or browsing.

The general idea of metadata based search is that, for a given type of cultural entity (for instance, creators), the whole collection of web pages can be used to mine information about each particular entity that is not present in the individual documents. For instance, the set of all documents talking about Van Gogh can be used to create a profile of the



terms most closely associated (i.e. co-occurring more frequently) with Van Gogh. This profile can be subsequently used to compare Van Gogh with other creators. The implication is that for each type of entity considered, MultiMatch must have an index containing such descriptions. As an example, let us consider that the user intends to search using the *creators* metadata field. The user is expected to type in an author's name plus (optionally) additional free text to retrieve relevant information related to the creator (i.e. artist, composer, writer...). Once the author is input, the system will retrieve different types of information accessible for the user using navigational items such as tabs: for example, it may retrieve web pages with the title plus snippets (as shown in Figure 6), a graphical depiction of the author's network of relationships to other authors, an author's tag cloud with those keywords most representative of the author according to the indexed material, a list of works of art related to the author, a list of cultural heritage sites which host content related to the author.

The *Composite search mode* supports queries where multiple elements can be combined. For example, it will be possible to search using the metadata fields associated with each document, but combining this restriction with free text and/or image similarity searches.

## 5. Conclusion

The MultiMatch project, funded by the European Commission under FP6 (Sixth Framework Programme), began in May 2006 and will finish in November 2008. A preliminary version of the MultiMatch search engine will be available in September 2007, while the final version is expected for September 2008. The consortium comprises eleven partners, representing the relevant research, industrial and application communities. The academic partners are: ISTI-CNR, Pisa, Italy (Coordinators); University of Amsterdam, The Netherlands; LSI-UNED, Madrid, Spain; University of Geneva, Switzerland; University of Sheffield, UK; Dublin City University, Ireland. Industrial members of the consortium are OLCC PICA, UK, and WIND, Italy. The cultural heritage domain is represented by Alinari, Italy, Sound & Vision, The Netherlands, and the Biblioteca Virtual Miguel de Cervantes, Spain. More details on the project can be found at <http://www.multimatch.org/>.

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**Multimatch** Authors

All  Authors  Artworks  Sites  News  
 Author:  Keywords:   
 Images  Video  Browse Multimatch Contents

Sign in >>

Results for "van gogh" - 4 biography pages | 4 artworks related pages | 6 reviews pages | 2 news | 2 Not categorized sites

Classified Web Pages | Author Space | Artworks | Sites | More

Sort by Category | Sort by Concept | edit

**Categorized Results**

**Profile**

**Name:** Vincent Van Gogh  
**Birth:** 1853  
**Death:** 1890  
**Country:** Holland  
**Category:** Painter

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**Biographical Data**

WebMuseum: Gogh, Vincent van  
 His father was a Protestant pastor, and van Gogh first trained for the ministry... for the 20th-century vogue in romanticized psychological biography...  
[www.fbblio.org/vm/paint/auth/vgogh](#) - 13k - Cached - Similar pages

Vincent van Gogh Online  
 Biography of the artist Artcyclopedia "Tragedy and Triumph at Arles. Van Gogh and Gauguin" Arnet Magazine *Poissant Woman Against a Background of Wheat, 1890*...  
[www.artcyclopedia.com/artists/van\\_gogh\\_vincent.html](#) - Similar pages

Tate Collection | Vincent van Gogh  
 Vincent van Gogh, 1853-1890. Dutch painter of landscapes, figures and still life. Born at Groot-Zundert, son of a panner. Entered the firm of Goupil...  
[www.tate.org.uk/soledit/ArtistWorks?og=ogpides090909](#) - 965k - Cached - Similar pages

ArtLex on Post-Impressionist Vincent van Gogh  
 Post-Impressionist Vincent van Gogh, with images of his works, great quotations... for the twentieth century vogue in romanticized psychological biography...  
[www.artlex.com/ArtLex/p/positimp.vanGogh.html](#) - 41k - Cached - Similar pages

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Van Gogh dispute is coming to a head  
 Sydney Morning Herald, Australia - Oct 11, 2006  
 ... of Victoria, Dr Gerard Vaughan, is optimistic that research under way in Amsterdam will confirm the authenticity of the gallery's only Van Gogh painting.  
 Head ...

Van Gogh exhibit focuses on wheat, harvest themes  
 KSWO, OK - Oct 21, 2006  
 DALLAS A vibrant painting Vincent Van Gogh finished weeks before his death is the centerpiece of a new exhibit at the Dallas Museum of Art. ...

**Reviews**

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 Your reviews critiques of art shows and art exhibitions you liked or didn't like... The myth of Van Gogh - the tormented artist thumbed by society...  
[www.saatchi-gallery.co.uk/quick-critique/index.php?show\\_id=Van+Gogh+Museum&...](#)  
 28k - Cached - Similar pages

Van Gogh And Britain - Pioneer Collectors At Completion  
 Verney ...  
 A contemporary review in the Daily Chronicle asked if the artists were "maniacs or pioneers?" and described Van Gogh as "the fiery spirit of revolt" ...  
[www.24hourmuseum.org.uk/birmingham/news/ART35897.html](#) - 37k - Cached - Similar pages

**Other**

Vincent Van Gogh: Two Sunflowers, 1887  
 Back to article Vincent Van Gogh Two Sunflowers, 1887 The Metropolitan Museum of Art.  
[www.artcyclopedia.com/VanGogh-TwoSunflowers.html](#) - Similar pages

Van Gogh Museum: Press  
 Van Gogh Museum offers reward for information about theft of paintings. The Van Gogh Museum is offering a substantial reward of up to euro 100000 for ...  
[www.vangoghmuseum.nl/1016-news/bnieuws?act=donateurs\\_view&ds111&cat\\_id=4](#)  
 - 8k - Cached - Similar pages

Figure 6. Author Search: Classified Web Page results