User-generated Video Blogs Video Search

Technology Reports

# Searching User-generated Video Content based on Link Relationships between Videos and Blogs

*Due to the spread of digital cameras and video-sharing services, large amounts of user-generated video content are now being posted on the Internet. This makes it harder for users to efficiently discover content that they are interested in watching. As a means of discovering worthwhile content from this large quantity of video material, we proposed a video search method that focuses on networks formed by user-generated videos and the blogs that link to them, and we implemented this search method as an application.*

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## 1. Introduction

In recent years, multimedia content has broken free from physical media such as CDs and DVDs and can now be obtained online. Some content delivery service providers are also starting to offer video and movie delivery via applications. Meanwhile, users are not only interested in watching professional content from big businesses but are also diversifying into user-generated content. For example, there seems to be an upsurge of commercial interest in niche markets such as fanzines and independent music artists.

YouTube™*1 is a typical example of a service that supports the online circulation of user-generated content. In January 2009, it was reported that the number of people using YouTube in the United States every month had passed 100 million (comScore U.S. survey report). Video content is now used very heavily.

But unlike Web space, which is built from HTML documents where hyperlinks provide a structure for cross-referencing, the data structure of video content does not include links to other content. This makes it hard for users to browse content by following links as when surfing Web pages. It could thus be said that video content is a medium where it is difficult for people to discover content they are interested in, and which still has a high threshold except for heavy users. To break through this issue, we have proposed a video search method that focuses on the networks formed by user-generated video content and the blogs that link to it as a means of discovering content of value in user-generated video.

In this article, we describe this proposed method and an application that uses it.

## 2. The Issue of Video Findability

The findability of information is determined by various factors ranging from the data structure of the content to the design of the platform on which it is provided. Since the data structure of video content does not include text data or hyperlinks, search techniques for

*1 **YouTube™**: A trademark or registered trademark of Google, Inc.

video content generally work by matching and extracting keywords from the plain text or tagged text appearing in the vicinity of the content. However, the surrounding text and tags do not provide a consistently objective representation of video or photographic content, and with a simple keyword search it is difficult for a third party to accurately find the desired content from among the diverse variety of content available.

To improve the findability of content, some businesses are providing Web browser add-ons with a function for displaying a thumbnail list of video content in order to increase the visibility of video and still image content introduced and provided by the site.

These thumbnail lists and the ability to view content by selecting it from a thumbnail not only makes it faster to see a summary of video content but also makes content browsing more convenient. However, they do not provide a means for guiding users from the content they are viewing towards other related content.

YouTube addresses this issue by displaying information such as thumbnails and titles of related video content when a user has finished watching a video. By selecting one of these thumbnails, the user can play back the corresponding video. This provides users with a means of playing back other videos they are interested in by selecting the corresponding thumbnail. In this way, YouTube builds a link structure between similar videos, and provides users with a means of following related content.

Although YouTube includes a function for suggesting related videos by presenting a list of videos that appear to be highly related to the current video based on a predetermined relevance calculation method, it is impossible for users to find out the basis on which these videos were selected. In other words, the reasons for displaying a particular selection are not made clear and there is insufficient information on why these videos are being recommended to the user. This makes it hard for users to judge whether or not they should follow these recommendations. It is thus thought that there is a need for content navigation to be provided in a new more convenient way compared with current methods.

## 3. Hypothesis Testing

First, to improve the findability of video content, we focused on the fact that Internet users use video embedding tools and the like to insert recommended videos in their own blogs. We studied this search method by testing our hypothesis for a network centered on user-generated video content.

### 3.1 Hypothesis Relating to Video Content on the Internet

According to a report by the Ministry of Internal Affairs and Communications, there were 16.9 million bloggers on the Internet in Japan in January 2008, and between them they had written approximately 1.35 billion articles [1]. Blogs have rapidly become a popular way for people to effortlessly express their opinions on everyday events, and some 3 million blogs (almost 20% of the total) are updated at least once a month. At the same time, many video-sharing sites that handle user-generated video content provide functions that make it easy for users who publish information on the Web to embed videos in their own blogs and Web sites. Such functions not only promote the publishing of information by utilizing videos and other multimedia content as well as text, but are also thought to facilitate the construction of new networks on the Internet due to the strong expressive capabilities of video content and the ease of user cooperation.

In this study, we put forward and test the hypothesis that user-generated video with lots of views is linked to from many Web pages, and that these linking pages link to other videos, thereby constructing an independent network with video content as nodes.

### 3.2 Summary of Test Results

In experiments performed to test the hypothesis [2], the following facts became clear:

- As a result of acquiring Web pages that contain links to the user-generated video content selected as sam-

ples (reverse links) from the Internet, we were able to obtain at least 100 Web pages in each case.

- As a result of analyzing these Web pages to collect the videos linked to from these Web pages (forward links), we were able to acquire up to 2,253 items of content.
- As a result of classifying the Web pages that link to user-generated video content, we found that blog pages accounted for approximately 40% of these pages.

### 3.3 Testing Method

**Figure 1** shows the data retention format of user-generated video information and Web page information, and **Figure 2** shows the procedure for extracting the link structure from this information. To acquire the Web pages linking to video content, we used the reverse link analysis function provided by an external search service.

As the user-generated video that provides the starting point for the data collection sequence, we selected videos that has been published at least one year ago and had received at least 10,000 views from five categories that appeared to be browser by viewers with different attributes. The specific categories were news videos, self-made clay animation videos, self-made robot videos, animal videos and self-made advertising videos. Between five and eight items of content were selected for each category.

### 3.4 Data Collection Results

In the experiments, we imposed the following restrictions:

- Acquire up to ten linking Web pages for each user-generated video.
- Finish when the total number of Web pages acquired has reached approximately 100.

The top three results in terms of the number of items of video content were extracted and summarized for each cat-

| Video ID | Video title | Video URL |
|---|---|---|
| 1 | P-38 Lightning, Arizona Air ... | http://www.mytube.com/watch/xx... |
| 2 | Searching for condors in ... | http://www.mytube.com/vxxx/yy... |
| ... | ... | ... |

Video table

| Web page ID | Title | Video ID | Web page URL |
|---|---|---|---|
| 1 | My Blog | 1 | http://www.myblog..... |
| 2 | Diary | 1 | http://www.mydiary..... |
| ... | ... | ... | ... |

Web page table

**Figure 1 Data retention format (video table, Web page table)**

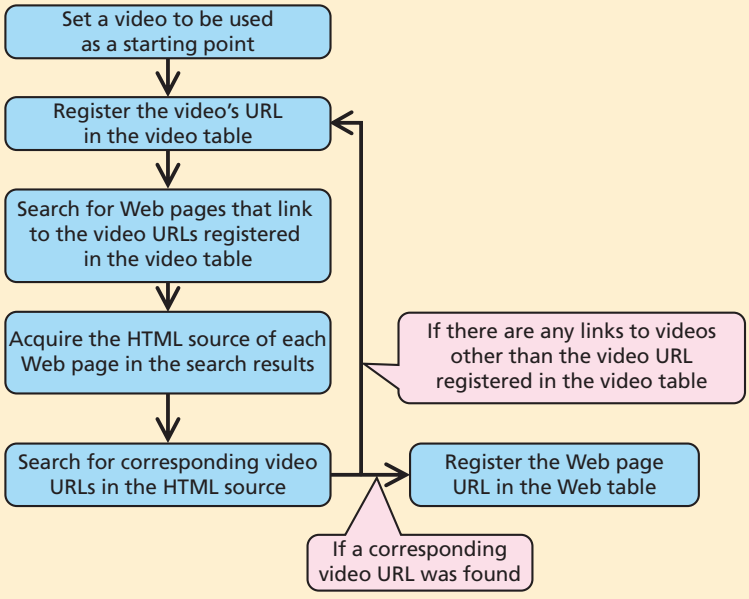



**Figure 2 Link structure extraction flowchart**

egory (**Table 1**). In each case, the number of acquired Web pages was never less than 100, and we were also able to collect an adequate number of acquired videos. This shows that there is a clear link structure between videos and Web pages, and that they form a fairly large network.

To classify the collected Web pages based on their content, we extracted 100 pages at random and classified them visually (**Figure 3**). As a result, we were able to classify them into four types – news sites, blogs (including the blogs of Japanese Web services and other sites with commenting and trackback functions and the like), bulletin boards and other pages. Regardless of the starting video category, we found that blog pages accounted for between 30 and 50% of the results while news pages and bulletin boards only accounted for a few percent.

### 3.5 Content Importance Calculation Method

We calculated the importance of each item of video content based on the reasoning that most of the content linked from good quality Web sites is good quality content. For this calculation, a good quality Web page was taken to be a Web page that most users consider when selecting video content. The variables necessary for this calculation are defined as follows:

- Importance of the linking Web page:

  A number added to and associated with a Web page containing a link to video content that a user views by visiting the Web page
- Number of links in the linking Web page:

  The number of items of video content that a Web page links to

An example of a calculation method is shown in **Figure 4**. The importance values attributed to linking Web pages W1, W2 and W3 (10, 12 and 3 points) are divided by the number of content items that these pages link to. The resulting values are used as weighting values for the linked video content C (5, 12 and 1.5 points). The importance information retained for video

**Table 1 Web page/video content acquisition results**

| Category | ID | Number of views | Upload date (YYYY/MM/DD) | Number of Web pages acquired | Number of video content acquired |
|---|---|---|---|---|---|
| News videos | N1 | 10,414,660 | 2007/01/10 | 102 | 1,737 |
| | N2 | 609,437 | 2006/12/10 | 101 | 1,361 |
| | N3 | 1,664,550 | 2007/01/27 | 104 | 1,333 |
| Self-made clay animation | C1 | 1,587,420 | 2007/12/08 | 103 | 973 |
| | C2 | 193,092 | 2007/09/26 | 102 | 954 |
| | C3 | 144,040 | 2007/12/08 | 105 | 786 |
| Self-made robot videos | R1 | 1,226,961 | 2007/08/25 | 103 | 1,764 |
| | R2 | 2,022,642 | 2007/03/27 | 104 | 1,268 |
| | R3 | 7,757,335 | 2008/03/17 | 101 | 908 |
| Animal videos | A1 | 17,387,750 | 2007/01/12 | 101 | 2,253 |
| | A2 | 4,523,041 | 2006/10/25 | 105 | 1,526 |
| | A3 | 12,168,739 | 2007/03/19 | 103 | 1,413 |
| Self-made advertising videos | K1 | 92,055 | 2007/03/16 | 101 | 1,724 |
| | K2 | 144,889 | 2007/03/07 | 101 | 1,009 |
| | K3 | 139,966 | 2007/02/01 | 104 | 973 |

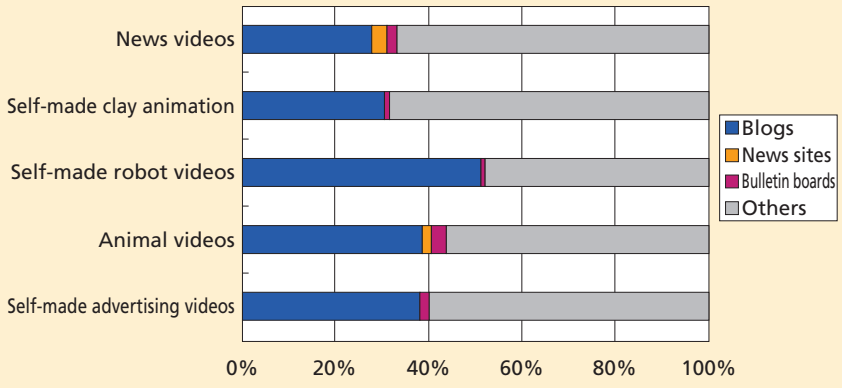



**Figure 3 Classification structure of extracted Web pages**

content C corresponds to the sum total of these values, which is 18.5 points.

By using these proposed methods to retain the importance values calculated from Web pages and video content, these values can be used as an independent ranking measure. The advantage of the proposed method is that video content linked from highly important Web pages (i.e., Web pages that are frequently referred to be users when selecting videos) is calculated as being of higher importance, so that it can be ranked more highly regardless of how many or how few times it has been viewed. For example, it is expected that even a high-quality video that has not had many views because it is not made for a general audience will float up higher in the rankings if it is linked from a Web site owner trusted as an introducer.

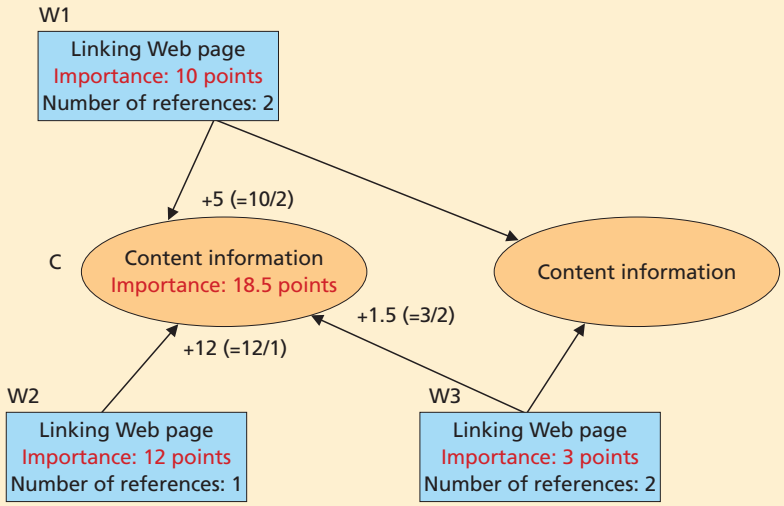


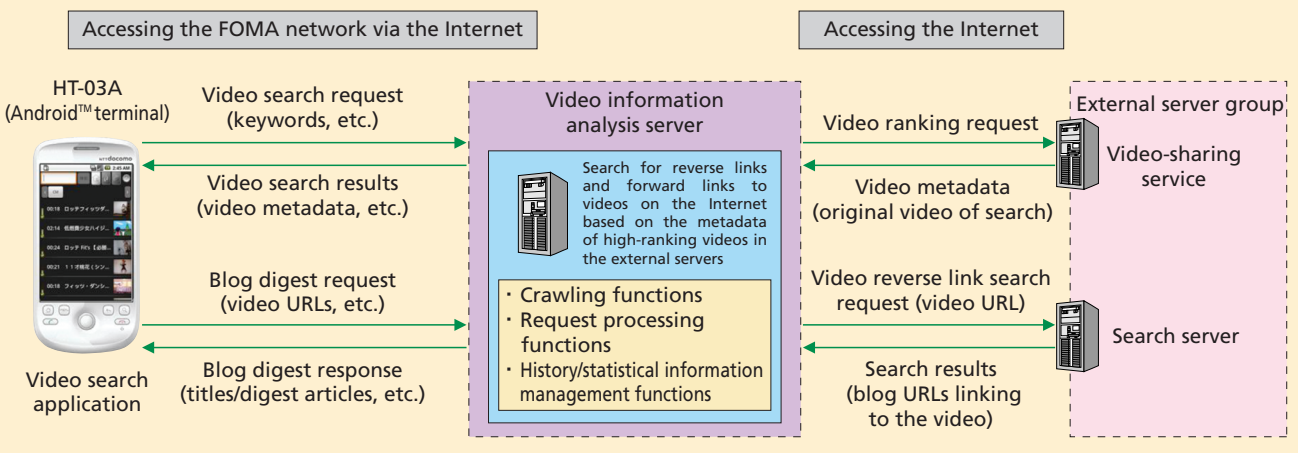

**Figure 4 Importance calculation example**

## 4. User-generated Video Navigation System

We proposed a link extraction algorithm that forms the basis of this system, and we tested its effectiveness by using it to collect real data. We also devised methods for using link information to calculate the importance of content, and we constructed a prototype system incorporating these methods.

### 4.1 System Overview

The system configuration is shown in **Figure 5**. The system comprises three elements – a video search application that runs on an HT-03A terminal, a video information analysis server that performs processes such as extracting link relationships, and an external serv-




Android™ : A trademark or registered trademark of Google, Inc.

**Figure 5 System overview**

er group on the Internet.

### 4.2 Video Information Analysis Server

The video information analysis server consists of the following three functions:

1) Crawling Function

This collects data based on a link relationship extraction algorithm. It combines the functions of searching for forward links based on a search for reverse links from the reference video, creating blog digests and acquiring video attribute information such as video thumbnail URLs, and thereby continuously collects Web pages and video content information. The collected information is stored by converting it into a database structure. The blog pages collected here were obtained from Japanese providers as Web services.

2) Request Processing Function

This receives requests from the video search application by HTTP, processes these requests, and sends back the processing results such as video searches and blog digest requests.

3) History/Statistical Information Management Function

This function receives information on the view counts of video content and the viewing histories of individual users, the hit counts of Web pages and the browsing histories of users from the video search application, and collects and stores this information on the server. The importance calculations are performed based on the numbers stored by this function.

### 4.3 Correspondence of Video Search Application and System Processing

**Figure 6** shows the correspondence between operations from the video search application and the data-

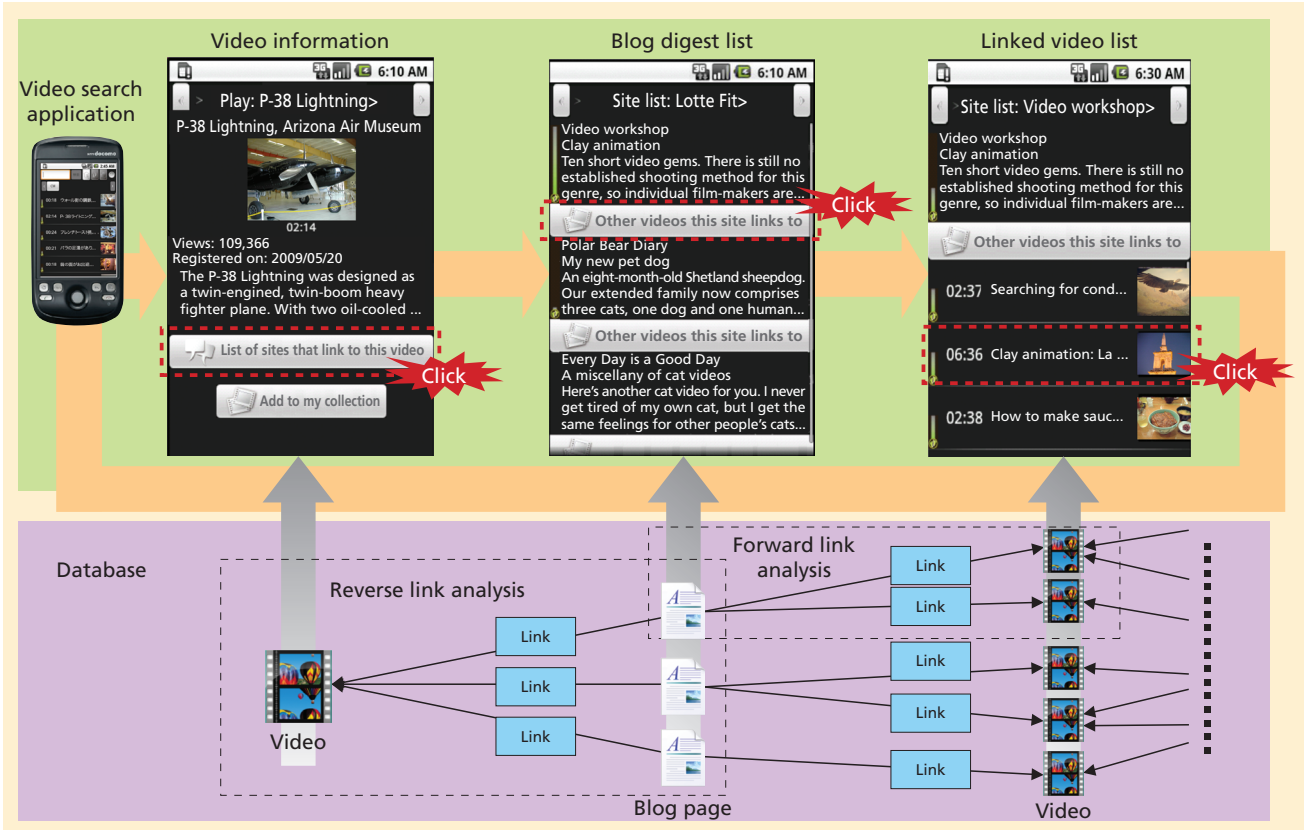



**Figure 6 Operations from the video search application**

base that is stored in the processing of the video information analysis server. The video information window, blog digest list window and link destination list window correspond to the videos themselves, the blog pages that link to these videos, and the other videos that these pages link to. The blog and video lists are sorted based on the results of importance calculations.

Since this system displays a list of the blog pages that link to video content as a means of conveying information relevant to this video content, it can be expected to enable users to obtain information relating to the popularity of videos from the number and content of blog pages that link to them. Also, whenever a user watches the video content that a blog page links to, the ranking of this blog page increases. Blogs with higher rankings can thus be regarded as video content connoisseurs, and these blog pages can be relied on when searching for other video content.

## 5. Conclusion

In this article, we have described an overview of a system that implements a video search method using the link relationships between video content and blogs with the aim of popularizing the use of video content on mobile terminals. The basic concepts of the search method and importance calculations presented here are applicable not only to video content but also to multimedia content such as photos and music, and downloadable content such as application software.

With the introduction of the High Speed Uplink Packet Access (HSUPA) service, it is expected that there will be a lot more video content uploaded to the Internet from mobile terminals. Internet culture tolerates all manner of creative values, and has come to occupy an important position as a source of activity among creators and users. Now that Internet use is shifting away from PCs and expanding into mobile terminals, services that provide a point of entry for mobile terminals can be said to bear a large responsibility for the further development of this culture. Based on this system's test results, we plan to continue developing technologies and services that can reliably and proactively bring users into contact with information by working to improve the findability of information.

### References

[1] Institute for Information and Communications Policy: "A Survey Study of Blogging," Mar. 2009 (In Japanese).
[2] K. Noaki, M. Terada and H. Sekino: "Reference Structure Analysis for Video Searching Via Web Pages," DICOMO 2009, pp. 36-42, Jul. 2009 (In Japanese).