Tags, Micro-Tags and Tag Editing: Improving Internet Search

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ABSTRACT

Social tagging is an emerging methodology that allows individual users to assign semantic keywords to content on the web. Popular web services allow the community of users to search for content based on these user-defined tags. Tags are typically attached to a whole entity such as a web page (e.g., del.icio.us), a video (e.g., YouTube), a product description (e.g., Amazon) or a photograph (e.g., Flickr). However, finding specific information within a whole entity can be a difficult, time-intensive process. This is especially true for content such as video, where the information sought may be a small segment within a very long presentation. Moreover, the tags provided by a community of users may be incorrect, conflicting, or incomplete when used as search terms.

In this paper we introduce a system that allows users to create “micro-tags,” that is, semantic markers that are attached to subsets of information. These micro-tags give the user the ability to direct attention to specific subsets within a larger and more complex entity, and the set of micro-tags provides a more nuanced description of the full content. Also, when these micro-tags are used as search terms, there is no need to do a serial search of the content, since micro-tags draw attention to the semantic content of interest. This system also provides a mechanism that allows users in the community to edit and delete each others’ tags, using the community to refine and improve tag quality. We will also report on empirical studies that demonstrate the value of micro-tagging and tag editing and explore the role micro-tags and tag editing will play in future applications.

Keywords: Social tags, multimedia search, micro-tags, tag editing, search semantics, perception, empirical study

1. INTRODUCTION

Internet search has revolutionized information retrieval, making web pages and media instantly accessible. People can find URLs, bookmark them, tag and comment about them (e.g., De.lici.ous), and integrate them into other web media. They can associate tags to videos (e.g., MotionBox) and use tags to describe books on Amazon. Operating at the level of the whole content, however, can be limiting. It can be very laborious to find information within a web page, video, text document, or software code. The tools for creating more granular segments are awkward, and there is no mechanism for annotating these segments in a way that will make them amenable for search. This means that an enormous wealth of information is currently unavailable to on-line search. This information cannot be found, cannot be integrated into other media, and is not available to the social community.

One main issue is that the complexity of the object being tagged (e.g., a video, a long document, or a software code) cannot be captured by a simple set of tags. There may be many different concepts, or topics within the object that are not captured by the set of tags or keywords. Moreover, different topics and concepts occur at different places or times within the complex media, so even if a complete set of tags were provided, they would not provide a sufficient index to the desired information. For example, if a political reporter or a concerned citizen wanted to see how the 2008 presidential candidates described their economic policy, a web search engine would not retrieve the appropriate campaign videos unless they had been tagged “economic policy.” Imagine instead that the production company or previous viewers of the video had been able to mark segments of the video with the term “economic policy” and that using these tags as search terms provided a URL with pointers to the appropriate segments within the video. These “micro-tags” would enable the user to access targeted information quickly and efficiently.

Micro-tags could be very concrete (e.g., marking a person or an object). Concrete tags could help find information hidden deep within videos or other media. In Amazon, for example, there may be a tag for “Orlando Bloom” associated with the Fellowship of the Rings video. If the segments where Orlando Bloom were tagged, these “micro-tags” could be searched, and a quick click on the URL would take them to these segments. Micro-tags can also be abstract. Imagine searching for examples of irony. If you type “irony” into Google, the search returns articles and web sites about irony, but does not focus in on examples. With a micro-tagging system, a user could assign any tag to a segment, and the tag would become search metadata. This would also serve to broaden the usage of tags, which would in turn broaden the types of search that could be performed.

The ability to create micro-tags would allow users to be creative about their tagging behavior. The common trend in social tagging is to enforce a standard set of tags. With micro-tagging, each user can assign meaning as he or she sees fit. Since these tags are not required to be generic, we anticipate the creation of a richer set of tags, designed to describe more specific quanta of information. At the same time, we anticipate the creation of more abstract tags, such as in the example described above, or “irony”.

We believe that providing a mechanism that gives the user more freedom to specify tags, which use human intelligence and perception to inform tags, will have a direct impact on search engines. The trend will be to create search engines that are more matched to how people conceptualize information and less matched to how indexing schemes can best operate on information.

Although there have been solutions that allow users to create "micro-tags" in the media they produce (e.g., YouTube), and there are many systems that allow users to create annotations in complex media [10], to our knowledge, there have been no solutions that surface micro-tags as search terms.

Whether the tags are assigned to the entire media content, or to micro-tags within the content, a key issue is tag quality [32]. Tag quality has primarily been addressed by using user ratings or votes (such as PageRank, or tag agreement counts) to refine the taxonomy. In this paper, we provide a new mechanism for tag quality improvement, which we call tag editing. In tag-editing, subsequent users can edit or delete tags assigned to content. Since tag editing can potentially reduce tag redundancy and correct errors, we hypothesize that tag editing will improve tag quality, which is critical if these micro-tags are to be effective as search terms.

![Figure 1](image.png)

Figure 1. The timeline for a video or sequence of content is depicted. Traditionally, users generate tags for the entire media (1). With micro-tagging, segments within the media can be identified, either by a human or a computer algorithm. These micro-tags (2) are each assigned a URL. Users can use this URL to search for segments in a single medium or across media. These micro-tags can be composed into documents or other presentations. These micro-tags can be edited by the community to improve their quality, reducing redundancies, and correcting inaccuracies.
2. VISION FOR MICRO-TAGS, TAG EDITING, SEARCH, AND COMPOSITION

We propose an infrastructure that allows users to easily create, annotate, edit, search and compose video, image, text, and software clips. In this universe, users searching the web would have access to information hidden deep within media content. This content would be created by giving users the ability to create "micro-tags".

Figure 2 shows a schematic of the general architecture. The media is depicted at the bottom of the diagram. It can have a timeline, like a video, or a sequence, like a book or software code. In this diagram, the timeline or the sequence of the content is shown, and there can be tags associated with the content. For example, this could be the timeline of a video or the sequence of an on-line book or web page, with descriptive tags. The top part of the figure shows that a micro-tag is a tag that is attached to a segment of shared content.

Micro-tagging allows semantic information to be attached to a segment of content either by a human or by an algorithm. A video micro-tag, for example, could contain information about the clip's start and end times, a spatial region, and a textual description of the content. The video tag would point to a segment of the video file. A text micro-tag could contain information about where in the text-stream the tagged clip had occurred and provide textual annotation about the content, or meta-information about its intent. If each of these clips had its own URL, then they could be posted in Del.icio.us or searched by internet search engines.

The key idea, thus, is that these micro-tags would be searchable entities, as ubiquitous as current web page URLs. This builds on previous work, in which micro-tags and annotations have been added to media (see related work), but takes this work one step further by making each of these micro-tags a separate search term.

Using micro-tags as search terms would help the search engine return more relevant information to the users. The list of URLs would point to segments within shared content that contain the indicated search terms, making it easier for the user to home in on the information requested. The micro-tag URLs would be part of the set of URLs returned by the search engine, so that the user would be able to view relevant web pages as well. To be able to tell micro-tags from URL-tags could be represented in the URL, itself. For example, the URL could contain a unique icon, code, or textual representation indicating that it was a video clip, a poetry clip, or a clip of software code) [16, 17].

We also envision using the community of on-line users to continually improve the quality of the textual descriptors for these micro-tags. Since these tags are smaller, and more likely to represent a single concept, the textual information could easily benefit from editing and refinement. In one usage scenario, users may be tagging animals in videos. The creator of a clip might call it "mammal," successive users might refine it to "otter" then "river otter". With a set of successive users editing the tags associated with these clips, the quality of these tags as search terms would improve.

Ubiquitous micro-tagging with community editing would enable large numbers of new applications. It would be easily possible to annotate legal documents with just the right clips from the depositions, or annotate marketing or strategy reports with just the right set of clips from briefing videos. It would be possible to clip and annotate segments from multiple sources to re-assemble for scholarly reports or video montages. It would allow people to tag documents with semantic metadata that would allow them to find examples of "biblical references" or "irony" or "propaganda". It would allow the collaborative on-line community to clean up errors that clutter the internet, where images are mislabeled, quotes misattributed, and medical images misrepresented. It would make information hidden deep in long videos, complex public codes, and impenetrable documents see the light of day, and experience a new generation of searchers. Within the enterprise, it could help unlock information hidden deep in video libraries and software archives.

Once micro-clips are easily taggable and searchable, the next step will be to compose these clips. Users will be able to create their own composites. For example, a lawyer could compose a document including key quotes from an important testimony in which small references of big importance could get the attention they deserve. Citizen journalism could reach a new level, with web pages containing micro-clips of supporting video.
3. EXAMPLE OF WHY MICRO-TAGS ARE NEEDED

To get a handle on the density of information in video data, we examined the 20 most searched celebrities in Reuters Labs Viewdle videos [15]. These videos provide video vignettes of celebrities. Each video is tagged with the names of all the celebrities that appear in the video. A histogram of the percentage of on-screen time for these 20 celebrities is shown in Figure 2. From a pool of 1202 videos posted since July, 2008, we observed that a celebrity appeared in a video on average 18.5% of the time. That is, a user downloading the video searching for George Bush or Hillary Clinton, for example, would have to watch the video for up to five times as long as necessary in order to see the clip they requested. In the 30 videos that included Ehud Olmert, he only appeared in 8% of the video, which means viewers searching for a clip of the Israeli Prime Minister had to sit through up to 92% of the video without seeing the clip they desired. Moreover, once they had viewed the clip, they had no way of storing the clip, sharing the clip, or integrating it into a document or other composed entity.

![Image of Figure 2. Proportion of time the 20 most search celebrities in 2012 Reuters Show Biz videos appear. The average appearance time is 18.5%, which means that viewers need to sit through up to 81.5% of the video in order to see the desired segment.]

4. THE SYSTEM

We propose a viral system that allows users to identify information clips, append metadata that can be used for search, and edit these tags in a social computing environment. A screen shot of our prototype system is shown in Figure 3. In this figure, the user has just added a micro-tag indicating that the celebrity is Madonna. Users can add, edit and delete micro-tags.

The prototype for this system is based on the InSight application [40]. This system includes a custom Adobe Flash/Flex based client player, running in a web browser, and a server application for storing and retrieving the video and the micro-tag metadata. The server application is built using an HTTP server (Apache), a database and a server-side scripting language (PHP). Within the database are several tables for managing the micro-tags, including a video table, a users table and a tags table. A video can have zero or more tags and each tag can be associated with a temporal and spatial region of the video which in this study system are stored as properties of the tag. A tag can be created, edited and deleted by a user of the system. Each modification to a tag is recorded so a change history is available. Both the tags and their change history are used in this study to track how the tags change and improve over time and allow us to compute the effectiveness of micro-tagging under different scenarios. For each micro-tag, a URL is created, capturing the beginning and ending times of the tag as well as the textual tag. We also create a URL that includes the tag ID in the system database.
5. EXPERIMENTAL STUDY

An empirical study was conducted to test whether users could 1) create micro-tags in complex media, 2) whether social collaboration would improve the quality of micro-tags as search terms, and 3) whether collaborative tag editing would improve the quality of user-created tags. To do so, we conducted an experiment in which 42 users created micro-tags identifying celebrities in three Reuters Show Biz videos [20]. Each observer tagged three videos. In one condition (“Add”), their job was to simply create micro-tags. To do so, they marked a temporal interval, a spatial location within that interval, and assigned a celebrity name to that video clip. In a second condition (“AddSee”), each user had the benefit of seeing previous users’ tags. This allowed us to measure the effect of social collaboration. In a third condition (“AddEdit”), each user could see previous observers’ tags, and could also edit or delete tags. This condition allowed us to test the value of collaborative editing to improve the quality of these search terms. We expected the quality of micro-tags to improve with editing, in the way that a wiki’s content can improve with community participation. Our hypothesis was that the ability for users to edit previous users’ tags would produce successively better search terms, since this editing process would be expected to correct errors, filter out inaccuracies, and reduce clutter. The communal result would thus be predicted to converge on a more accurate set of tags identifying events in the video.

Three short Reuters’ ShowBiz News videos were used as test materials. Each video consisted of a compilation of clips about current celebrities. Each video contained between 10 and 16 celebrities. To evaluate the quality of the spatial and temporal metadata, we compared the user responses with physical ground truth. To measure the quality of the textual tags, we used an explicit search criterion. We measured the degree to which the user-generated tag produced successful “hits” when used as a Google search term. For each text tag provided, we measured the degree to which the identity of the celebrity was correctly identified on the top level of the top ten Google responses (by counting the number of references to the name of the target celebrity). For each observer, we computed a cumulative percent correct. This score reflected the total percent of all celebrities correctly identified by that observer and all previous observers in that condition.

Results for one of the videos are shown in Figures 4 and 5. For spatial, temporal, and celebrity naming, the accuracy of the tags benefited from the social community. For all three videos, seeing previous tags improved overall performance, and collaborative editing provided even greater accuracy. Figures 4 and 5 show data for one video. The same effects were observed for the other two videos, which are described, with additional analysis, in Topkara, et al [40]. Figure 4 shows data for spatial and temporal metadata accuracy. The average individual score is shown as a horizontal line. Relative to this baseline, seeing other’s tags did improve the contribution of each successive user (AddSee condition). In the AddEdit condition, where observers could edit and even delete previous observers’ results, tag quality increased faster than in the AddSee condition and resulted in a higher level of overall quality.

The left-hand panel of Figure 5 shows data for the textual component of the tag. As with the spatial and temporal data, the quality of the tag names increased over baseline when observers could see previous tags. That is, the tags they generated were successively more successful as search terms, using the method described. The quality of the name tags...
Figure 4. Observers were asked to create spatial, temporal, and name micro-tags for the video segments that contained celebrities. These two graphs show their ability to tag the correct spatial region and temporal interval where the celebrities occurred. Tag correctness (measured as a percentage) is measured for successive observers. Baseline percent correct is shown as a horizontal line. Being able to see others’ micro-tags significantly increases tag correctness above the baseline (AddSee in squares). Quality improves faster, and achieves a higher asymptotic value when the observers are also allowed to edit and delete preceding tags (AddEdit- in diamonds).

Figure 5. With successive users, tag Editing produces higher quality tags (left) and also results in fewer tags (right). The left-hand graph shows observers’ ability to name celebrities. Overall tag correctness is measured for successive observers. Baseline percent correct is shown as a horizontal line. Being able to see others’ micro-tags significantly increases the quality of the names produced (AddSee in squares). Quality improves faster, and achieves a higher asymptotic value when the observers are also allowed to edit and delete others’ tags (AddEdit- in diamonds). Tag quality was assessed by the success of the tags in returning relevant links when used as search terms in a Google search. The right-hand graph shows that the number of tags used, overall, is less in the condition when users can edit each others’ tags (AddEdit, in diamonds) than when they can only see other tags (AddSee, in squares). When users can edit and delete previous micro-tags (AddEdit, in diamonds), fewer tags are created by the community.
improved faster, and achieved higher levels of accuracy with tag editing, making them successively better search terms over the course of the experiment. That is, whether the task was to identify the temporal interval where the celebrity appeared, the spatial location on the screen, or to name the celebrity, the ability to see others’ tags improved their quality as search terms, and this ability was further improved when successive observers could correct previous tags.

The right panel of Figure 5 shows a complementary result. Not only did communal editing of these micro-tags improve tag quality, but higher quality was achieved with fewer tags. While the number of tags increased steeply with successive observers in the condition where other’s tags could be seen, it rose slowly when micro-tags could be edited. That is, observers used the editing capability to eliminate redundant tags and to correct errors.

6. RELATED WORK

Our system builds on emerging concepts from social computing and applies them explicitly to the search environment. First, it builds on the notion of community tagging [25, 20, 30], in which information from multiple users can enhance the richness of information (metadata) available about on-line content. Second, it builds on the notion of micro-tagging, in which users can identify information within complex content [10, 9, 26, 23]. In this paper, we propose using micro-tags as search indices on the web, and to use the communal activity of a population of users to edit and refine the quality of these search terms.

Classifying Segments inside a Multimedia Object

There are many systems focused on automatic classification of media content [34, 15, 14, 21, 28, 42]. These systems mostly use pattern recognition and machine learning techniques to predict the class of an image or a key frame in a video. They typically use a fixed set of classes (e.g., set of people that can be recognized) and learn from training data that is previously annotated.

Our approach to media semantics builds on previous literature on community systems that take advantage of large numbers of people to identify information on a much larger scale than can be provided by a small number of experts. Peek-a-boo, for example, provides a mechanism for taking advantage of the community for image classification [41]. In the Galaxy Zoo project, the public classifies phenomena in images of galaxies [5], and the astronomers benefit from the action of the masses.

Looking to the future, we envision combining these two approaches. We can use automatic systems to populate initial tags, have users provide additional tags, and both sets tag editing or deletion. The users’ actions, in turn, can then be fed back to the automatic systems as training data. For example, a face-recognition system could provide initial tags for celebrity videos, whose training could, in turn, be enhanced by the behavior of a large population of human observers, who bring additional pattern-recognition and insight to the problem.

URL Links for Tags

Several video sharing sites are beginning to allow users to select a segment [7, 8], or time points inside a video [19, 13, 12]. Viddler and Veotag provide URL links for timed tags on their videos, where these time-tags are attached to a single point on the video timeline. All these systems, including InSight, use a streaming server to be able to provide seek into arbitrary points in the video. Our system differs from these previous systems in that a specific begin- and end-time is specified by the user. The URL for the micro-tag takes the user to the begin time and plays through to the user-specified end time. The user also has the option to watch video media before or after the tag, since micro-tagged segment is viewed in situ.

There is emerging standardization around spatial and temporal tags. There is a W3C activity in its planning stages looking to standardize the method for addressing temporal and spatial media fragments in the Web using Uniform Resource Identifiers (URI) [17, 16], independent of the content-owner or the interface.

In this paper, we propose generalizing the concept of providing a URL link for a video micro-tag to providing URL links to segments or objects in other media. To tag a segment of a web page, for example, the metadata stored on the server would point to the tagged segment. In order to point the user directly to that segment would require a plug-in that could
alter the DOM structure, allowing pointers to sections of an HTML page. The IBM Social Accessibility project uses a similar approach to add accessibility cues to any given web page [37].

**Micro-tagging**

Recently, many web-based tools have appeared that allow users to create comments within opaque media [9, 1], add point-tags on videos [13, 12] and include person-search micro-tags on photos shared on Facebook [4]. These features allow users to point viewer attention to certain parts of the photograph or to provide a better explanation of the captured image. A recent patent [23] describes a system in which a community can tag segments in streaming content. Also, attaching annotations to a timeline of streaming media or indexing the video recording of a talk or lecture with synchronized presentation slides has been studied in the distance learning domain [27, 24, 11, 33, 41].

Another group of related work is based on personal tagging systems, where users tag local content according to needs, such as search, organization or note taking [2, 22]. Similarly, qualitative data analysis software tools such as NVivo, in the ethnography domain, allow users to use tags and annotations to organize and retrieve their collection of materials, for video, interview recordings, documents, and photos [10].

There is also a set of web technologies that provide a way for users to take notes while surfing through the web, such as spartag.us [26], Diigo [3], and Google Notebook [6]. These systems allow users to highlight certain parts of a web page (usually by the help of a browser plug-in), and save the highlighted paragraph together with their bookmark in their bookmarks list in these repositories, and share their bookmarks with others. A user study performed on spartag.us, showed that users benefited from the ability to extract and tag part of a web page ("paragraph tagging" in this context) and only keep record of that part.

In [35], Storey et al. proposed a system to attach comments or tags to points in software code in order to semantically search and navigate within this code. These markers (i.e.,"waypoints") can be used to communicate between collaborating programmers, as the next programmer working on marked code can update it.

The related literature cited in this subsection allows users to perform tagging and annotation within a closed system (the site of web sharing process or via a specific tool). By contrast, in this paper, we propose a way to extend the application of micro-tags beyond closed systems and make them available for tagging any type of content on the web. In addition, we propose that these micro-tags can be improved by allowing several users collaborate in editing its content.

**Collaborative Editing**

ViaScribe [39] provides an interface for editing automatic transcription output for accessibility projects. In ViaScribe, only one user can work on the collaboratively fixed transcription. Our system is differentiated from these systems in the nature of the collaboration. In our system, the content is continuously shared and users collaborate simultaneously on editing the publicly available tags attached to this content.

**Tag Evaluation**

Another line of related work is on tag evaluation. In [32], Muller et al. suggest several metrics for evaluating the quality of tags. These metrics are based on analyzing the set of tags attached to the same resource in order to assign a quality score to each tag. They analyze the effectiveness of these metrics on an enterprise tagging system.

A widely-adopted way for decreasing the percentage of errors in tag quality is providing tag suggestions at tag creation time, in order to prevent users from creating tags that are synonyms, or tags that have typos [29]. In this paper, we propose a way to improve the tags’ quality after they are created.

7. CHALLENGES AND OPPORTUNITIES

As the web services that provide community micro-tagging become more common there will be several new problems. First, the sheer number of entities to search will increase, since each video, for example, will have many different, and often overlapping tags. Several technical challenges will arise in managing databases of micro-tags, tracking tag edits, and in providing and managing access control. New visualization metaphors will be developed to reveal the structure of
micro-tags and their relationship to the tags for the mother documents. And new user interfaces will be needed to facilitate the ease with which users can create, edit, search and compose micro-tags.

There will also be many new opportunities. For example, new technology will be needed to support new applications, such as using micro-tags to generate composites and digests. Recommender systems will need to work on micro-tagged subsets in addition to the full content. New summarization applications will appear that will include assembled micro-tags.

Perhaps most important, the use of micro-tags will free up information generally. Snippets of poems, clips of videos, bits of documents, and sections of images will all be independently addressable and independently searchable. People will be able to create and search for personalized tags, such as “for my son’s presentation”. It will be easier to find, merge, and mash-up information from multiple domains and sources into new types of composites. In some domains, wiki-tagging will bring about a convergence in tag names. In others, different needs and goals of different users will cause an explosion in unique tags. The freedom to clip and tag at a fine-grained scale will certainly affect our concept of internet search.

Figure 6 gives an early example of micro-tag search. Using the InSight system [40], users tagged several videos and were later able to search the tag metadata. The query “sea” retrieved video segments from four videos, ranging from 7 to 45 seconds. Clicking on the segment thumbnail allows the user to view the segment in situ.

8. CONCLUSION

Modern web search engines very effectively return links to web pages. Social tags and keywords provide good access to on-line content. Finding specific information within a URL or a video, however, can be a difficult, time-intensive process. This is especially true for content such as video, where the information sought may be a small segment within a very long presentation. Moreover, the desired information may not have been included in the set of key words or tags.

To address this problem, we introduce the concept of searchable “micro-tags” which allow users to identify and tag segments within a large shared content, such as a video. Tagged segments are assigned a URL, and the tags for the segment can be searched using traditional search technology. In addition, we introduce the concept of tag editing, which allows the community to edit and refine the tags, improving their quality as search terms. We also describe an empirical study that shows that users can successfully tag segments of video, that the search value of these micro-tags improves when users can see tags added by other users, and that micro-tag quality improves even more when users can edit and even delete each others’ tags. The concept of using editable micro-tags as search terms has been introduced and implemented within a video tagging context, but can easily be extended to other media, to search for content within web pages, long documents software codes, etc.

The concept of searchable, editable micro-tags builds on several foundations. First, it builds on the notion of community tagging, where it has been demonstrated that user-created tags can be valuable tools to search for web pages (e.g., Delicious). Second, it builds on the emerging phenomenon of user-created micro-tags that allow users to annotate
segments or regions within videos (YouTube) or documents. Third, it builds on the notion of using the community to improve content through community editing.

Together, these concepts can be combined to create a new search paradigm. In this view, users or algorithms can create micro-tags or annotations within shared media such as videos, software codes, documents or images. These micro-tags contain information at a finer grain than tags associated with the entire document, code, web-page, or video, since they are associated with a specific subset within the larger entity. By assigning each subset a unique URL, these fine-grained descriptors, annotations and labels can now be used as search terms. These search terms give users access to information currently hidden within large information sources. Furthermore, by allowing users to edit these search terms, their quality can be improved over time, correcting the clutter and misinformation that is commonly associated with user-provided tags.

Micro-tags can be created by algorithms or by human observers. Although automatic tagging can be very valuable, the value of the human contributor cannot be minimized. Human pattern recognition ability far surpasses computer-generated equivalents. For example, although an automatic face-recognition system can recognize people shown looking at the camera, humans can easily recognize faces from the profile, and often can identify partially-occluded or oblique views. More important, humans can identify concepts. A particular passage in a document may indicate “fraud”; a particular line in a poem might be tagged as “water as metaphor for cleansing”; a particular clip of a political video may be identified as “key Democratic platform”. We believe that capturing human semantic and conceptual knowledge through micro-tagging can enable greater richness and sophistication in internet search.

We believe that explicitly translating user-defined annotations and tags into search terms provides a new paradigm. In conventional tagging systems, where tags pertain to an entire document or video, the tags need to be general enough to describe a large proportion of the content's information. People are also biased to create keywords that are amenable to search by engines such as Google. If, on the other hand, the tag can describe a subset of the information, the user can assign a more focused tag, and more important, can use an abstract concept, as in, an example of "irony". We believe that providing a mechanism that gives the user more freedom to specify tags that are informed by human intelligence and perception will have a direct impact on search engines. The trend will be to create search engines that are more matched to how people conceptualize information and less matched to how indexing schemes can best operate on information.

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