Performance Evaluation of Image Search System Using Tag Ranking

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Abstract. The original tag-based systems have several problems. To solve these, previous research proposed cluster-based tag ranking and image search system using tag similarity. This research uses image search results’ accuracy and recall ratio to evaluate the proposed system.

Keywords: Tag, Cluster, Tag Ranking, Image Search

1. Introduction

Currently, many internet users highly praise tags and tags are widely applied to web documents like blogs and multimedia data[1]. However, despite the hope that tags will be reused and improve efficiency, the limitations of tags caused insufficient results.

To solve this problem, previous research[2] proposed cluster-based tag ranking and image search system using tag similarity. This research used the proposed system to real data and garnered accuracy and recall ratio to evaluate the performance.

2. Related Researches

2.1 Problems of tag-based system

Original tag-based search system[4,5,6] had the following problems.

First, subjective tags by the users create inaccurate tags.

Second, unorganized tags provide major cause for inefficient information search, because users do not consider relationship and priority order between tags.

These caused inaccurate search results. Thus, cooperative tagging[4], tag clustering[5], hierarchical structure of tags[6], tag-based searches[7], tag-based recommendations[8] are studied.
2.2 Ranking and Search System using Tag Similarity

This paper is based on the proposed system from previous research[2]. The system has 5 modules:

1. Tag Frequency Extraction Module
   It extracts co-appearing frequency and create TFM(Tag-pair Frequency Matrix)[9].

2. Semantic Similarity Extraction Module
   It uses TSSE(Tag-pair Semantic Similarity Extraction) algorithm based on WordNet to create TSM(Tag-pair semantic Similarity Matrix)[2].

3. TWM Creation Module
   Based on TFM and TSM matrix, TWM(Tag-pair Weight Matrix) is created.

4. Tag Clustering Module
   Based on tag-pair weight of TWM matrix, TBTC(TMWB ased Tag Clustering) algorithm is applied to cluster highly relative tags.

5. Tag Ranking Module
   Based on the results of Tag Clustering Module, CBTR(Cluster Based Tag Ranking) algorithm is applied to erase inaccurate tags on images.

3 Tag Ranking using Semantic Similarities

3.1 Experimental Data

This paper used Flickr’s Open API[3] to test the proposed system[2]. It used top 500 images including tags ‘lion’ and collected tag information. 12,588 tags were collected from 500 images with tag ‘lion.”

3.2 Frequency and Similarity Extraction

First, to test the performance, co-appearence frequency between tags on the images was extracted[9]. And then, to correct the infrequent tags that have highly relative meanings and subjective tags, proposed TSSE algorithm is applied to extract tag-pair semantic similarity.

TSSE algorithm and the method using tag-pair co-appearing frequency cannot be used alone; when they are used together, they can improve weaknesses of the other.

3.3. TWM and Tag Clustering


Proposed TWM (Tag-pair Weight Matrix) creation method [2] was used, and TWM with 3,346 tag-pairs as created from ‘lion.’

Research [9]’s proposed tag clustering algorithm that clusters highly related tags was applied to TWM. From 3,346 tag-pairs of ‘lion’ TWM matrix, 13 tag clusters with highly relative tags are created.

3.4 Cluster-based Tag Ranking

Four methods of [2] are applied to the previous stage’s experimental data for tag ranking.

As result, TWMR method is a better method that disregards subjective and unrelated tags. CBTR algorithm was applied for tag-ranking results that compose of high related tags with ‘lion’ among tag clusters. CBTR had highly usable result because it ranks the tags that are highly related to the wanted result.

4 Searches based on Tag Ranking

Following equations are used to weight the ranked tags from TWMR and CBTR algorithm. This is called SV (Search Value).

\[
JW_i = \sum_{j=1}^{\delta} TM_j (j, i) \tag{1}
\]

\[
SV_i = \frac{JW_i}{\delta} \tag{2}
\]

Figure 1 shows 5 images on the top from the search results and 5 images on the bottom that are disregarded based on CBTR algorithm.

![Search Results based on CBTR](image-url)
Top 5 images on the Figure 1 are highly related images with ‘lion.’ With the algorithm, inaccurate tags are erased and highly related tags are ranked.

4. Conclusions

5 Evaluation and Analysis

This chapter uses precision and recall to evaluate the system.

\[
\text{Precision Rate} = \frac{\text{Number of Accurately Searched Images}}{\text{Number of Searched Images}} \quad (3)
\]

\[
\text{Recall Ratio} = \frac{\text{Number of Accurately Searched Images}}{\text{Number of Total Images}} \quad (4)
\]

Accurately searched images of the above equation are images with related tags and inaccurate tags are images without related tags.

From Flickr’s 500 images of ‘lion’, 397 images were accurate 103 were not. Table 1 shows 500 images of ‘lion’ that are separated accurate and inaccurate based on TWMR and CBTR and other original search results. Precision and recall are also shown in this table.

Table 1. Search Results for Keyword ‘lion’ and Comparison of Precision and Recall

<table>
<thead>
<tr>
<th></th>
<th>Extracted</th>
<th>Accurate</th>
<th>Inaccurate</th>
<th>Precision</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>500</td>
<td>397</td>
<td>103</td>
<td>79.4%</td>
<td>79.4%</td>
</tr>
<tr>
<td>Frequency</td>
<td>430</td>
<td>365</td>
<td>65</td>
<td>84.9%</td>
<td>73.0%</td>
</tr>
<tr>
<td>TWMR</td>
<td>415</td>
<td>357</td>
<td>58</td>
<td>86.0%</td>
<td>71.4%</td>
</tr>
<tr>
<td>CBTR</td>
<td>391</td>
<td>357</td>
<td>34</td>
<td>91.3%</td>
<td>71.4%</td>
</tr>
</tbody>
</table>

6 Conclusions

Previous research[2] proposed cluster-based tag ranking and search system using tag similarities to solve the problem of original tag-based system and researches.

This paper experimented and evaluated the proposed system using 500 images for each tags of ‘lion’ and collected their information. Three areas were tested and evaluated. This paper used precision and recall to test the proposed system and concludes that proposed system improves on the previous systems.

References