Improving Yioop! User Search Data Usage

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Introduction

- Users past search history can be used to provide customized search results.
- Commercial search engines like Google, Bing provide this feature called as Personalized search.
- However, storing of this user data in the server has some privacy concerns.

Project Goal

- The goal of the project is to use the user search data and provide valuable features to Yioop User without any privacy issue
  - Provide a visualization tool to see the search history
  - Customize Yioop Search result based on past user searches
  - Provide related searches

Background

- We use Firefox extension for building the features because
  - Build user confidence as user can view the code
  - Provides Storage API to access browsers history
  - Easy to implement using popular scripting language like Javascript

Firefox Extension

- Extensions allow users to add functionality to the browser and enhance the user interface.
- They are distributed in the form of zip bundle with a xpi (pronounced "zippy") extension.
- Basic component of the extension
  - install.rdf
  - chrome.manifest
  - main.xul

Basic Components

- **install.rdf** – It contains details like unique id, version, min and max version of the target application details, etc. This file is read for installation.
- **chrome.manifest** – It contains folder hierarchy, skin details and the xul file to be overlaid on the browser.
- **main.xul** – It contains the UI details that needs to be overlaid on the browser. It also adds functionality by including JavaScript files.

User Data Visualization

- One of the user benefits is to provide a visualization graph of the users past search history.
- In this graph, the nodes represent the unique urls visited and the edge represents the navigation path to reach the url.
- For this, we are using Force directed algorithm to draw the directed graph.

Force Directed Algorithm

- In this algorithm, there are two forces assigned at the edges and the nodes

- **Hooke's Law** - If the spring is compressed or extended and released, it returns to its original, or natural, length, provided the displacement is not too great.

$$F_x = -k(x - x_0) = -kx$$

Where k is the force of constant of the spring

- **Coulomb's Law** - The magnitude of the Electrostatics force of interaction between two point charges is directly proportional to the scalar multiplication of the magnitudes of charges and inversely proportional to the square of the distances between them.

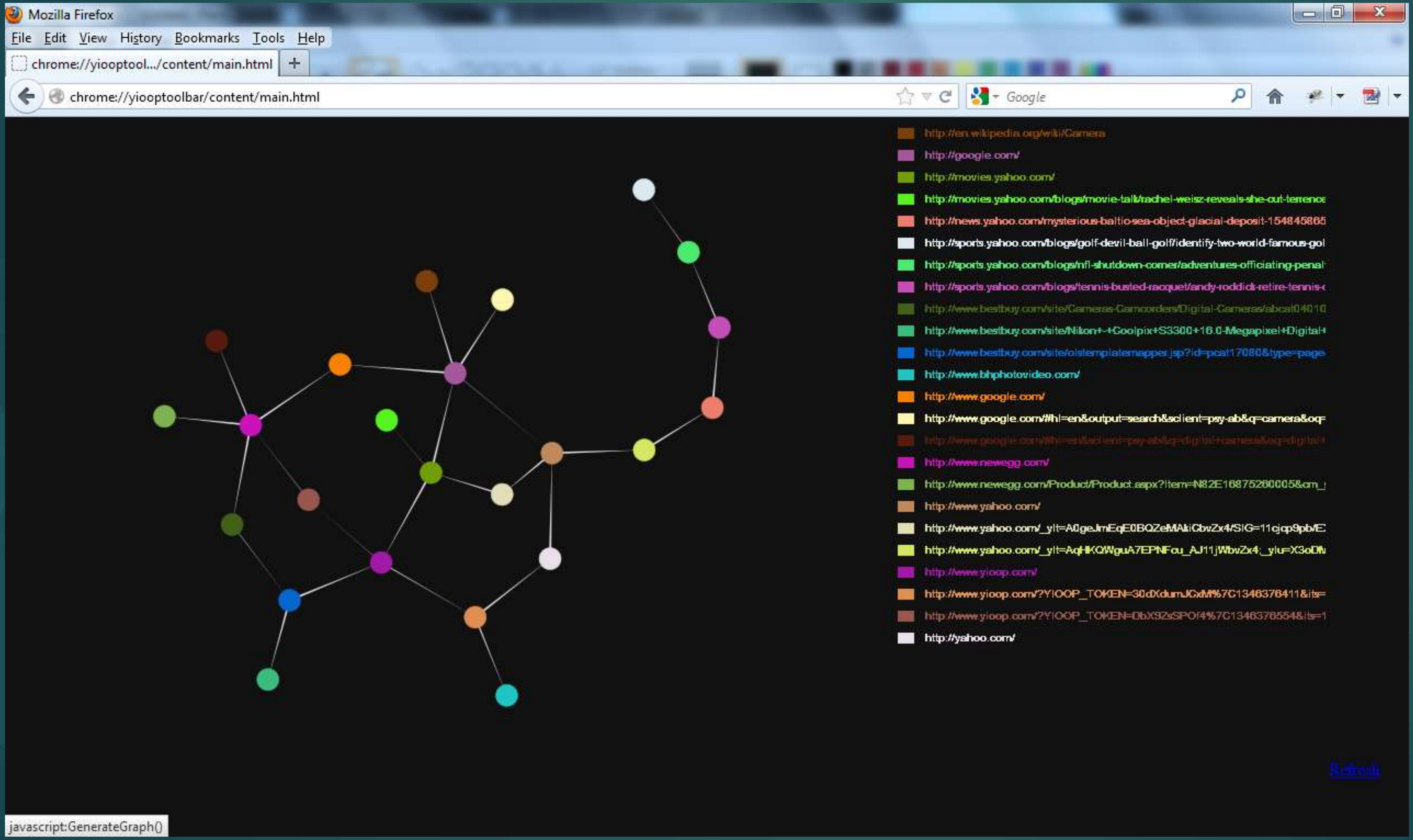
$$|F| = k_e \, |q_1 q_2| / r^2$$

Where K_e is the repulsion constant and q_1, q_2 are the two point charges.

Force Directed Algorithm

```
//Place the nodes at random position and
//intialize their velocity to (0,0)
Loop

    //Initialize the total kinetic energy
    kinetic_energy = 0;

    for each node
        // Net force of this particular Node
        net_force = (0, 0);

        // Calculate the effect of Coulomb's Law
        for each other node
            net_force = net_force + Coulomb_repulsion (this_node, other_node);
         next node

        //Calculate the effect of Hooke's Law
        for each spring connected to this node
            net_force = net-force +  Hooke_attraction (this_node, spring);
        next spring

        //Update the velocity of the node using a damping constant(0 < d < 1)
        //Here, we are using the damping constant to be 0.5
        this_node.velocity = (this_node.velocity + timestep * net_force) * 0.5

        //Update the node's position
        this_node.position = this_node.position + timestep * this_node.velocity

        //Update the kinetic energy of the system
        kinetic_energy = kinetic_energy + this_node.mass * (this_node.velocity)^2

    next node

 until kinetic_energy < 0.01 //A small constant
```

Sample Graph



Re-rank Yioop Result

- The second goal of the project is to provide customized search result based user's past searches.
- Capture user searches and store it in the local machine.
- Re-rank the Yioop result page at runtime based on these data.

User Data for re-rank

- Capture user search data from other search engines like Google, Yahoo, Bing, Yioop.

Field	Information
keyword	The search query user entered in the search engine
url	The destination url the user reached by clicking the search result
title	Title of the destination page
visitcount	Keeps track of the number of visits
searchfrom	Keeps track of the search engine
timestamp	Keeps an update of the latest time stamp

Storage of user data

- The user searches are stored in the local machine.
- It is stored in the form of sqlite database.
  - Why?
    - It is lightweight
    - Easy to access using javascript
    - Readily available apis for data manipulation

How to manipulate the Yioop Result Page?

- Three ways to manipulate the Document Objet Model (DOM)
  - **Load Events** – Add a listener when the Yioop result page loads and start manipulating the DOM.
  - **HTTP Observer** – In this, the page is captured at the HTTP notification event and update it.
  - **WebProgressListeners** – More sophisticated way of intercepting and modifying at various stages of load event

Re-Rank Yioop Result

- Uses the “visitcount” to determine whether the result is included in the Yioop page.
- Use the “Load Event” method to manipulate the data.

```
window.addEventListener("load", function load(event) {
        window.removeEventListener("load", load, false);
        myExtension.init();
}, false);

var myExtension = {
  init: function () {
    // The event can be DOMContentLoaded, pageshow, pagehide, load or unload.
    if (gBrowser)
      gBrowser.addEventListener("DOMContentLoaded", this.onPageLoad, false);

    //Initialization logic can be put here
  },
  onPageLoad: function (aEvent) {
     //Code that manipulates the web page
  }
};
```

Existing Yioop Search Result

Web Images Videos News Settings Sign In

Yioop! fade Search

Results: (1.344735 seconds. Showing 1 - 10 of 228709)

FLASH:¿Cómo hacer un **Fade** por ActionScript? - Foros del Web
www.forosdelweb.com/wiki/FLASH:%C2%BFC%C3%B3mo_hacer_un_Fade_por_ActionScript%3F
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United States **Fade** To Blue Brand Jeans, United States **Fade** To Blue Brand Jeans Manufacturers, Unite
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Dynamic Drive DHTML Scripts- Textual tooltip II (**fade** into view)
www.dynamicdrive.com/dynamicindex5/linkinfo2.htm
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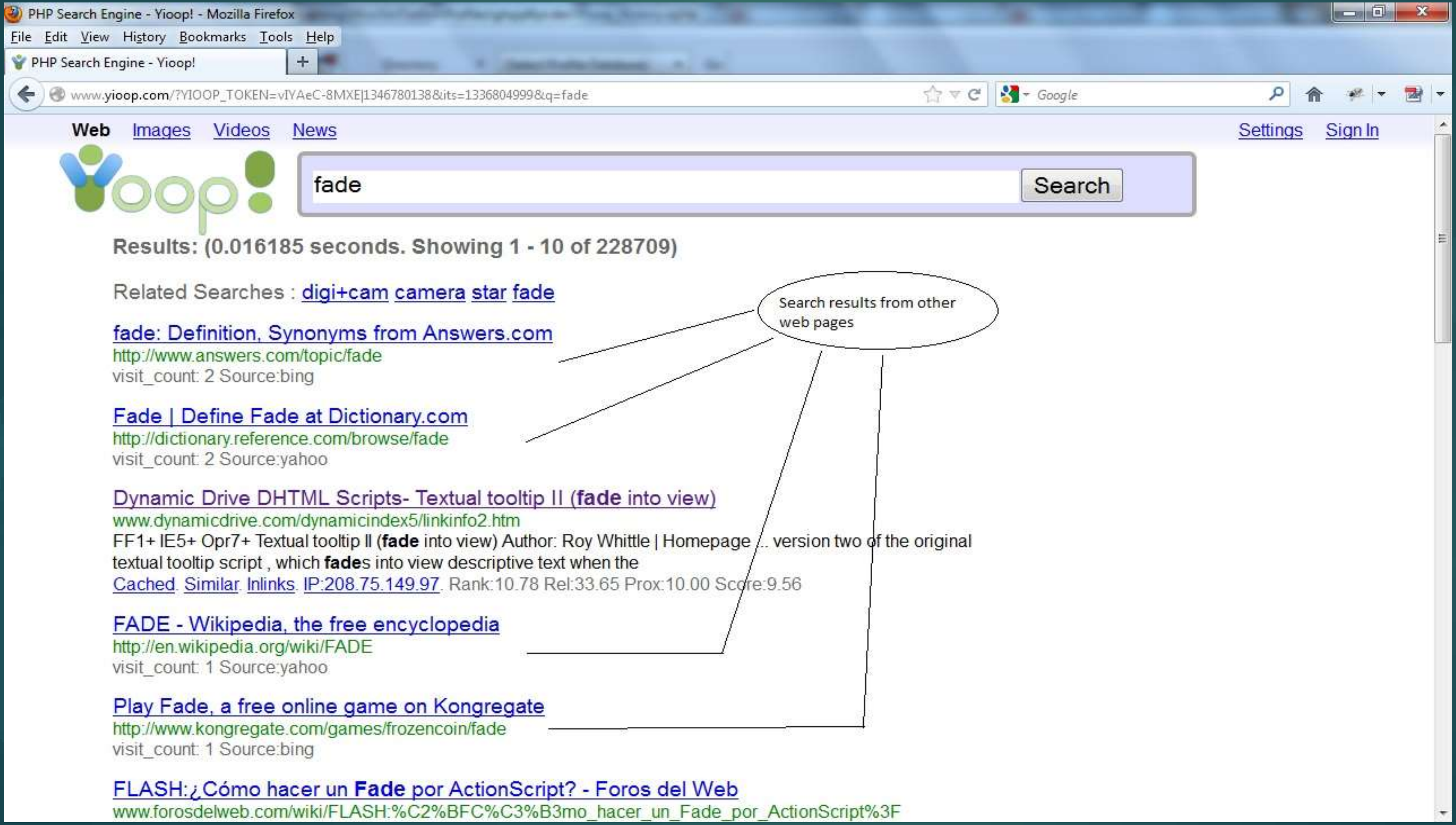
Re-ranked Yioop Result Page



Related keywords

- The final goal is to provide related keywords in the Yioop result based on the past searches.
- Use the past user search keywords and calculate the most relevant.
- We use Okapi BM25 to calculate the related keywords.

Okapi BM25

$$\text{score}(D,Q) = \sum_{i=1}^{n} \text{IDF}(q_i) \cdot \frac{f(q_i, D) \cdot (k_1 + 1)}{f(q_i, D) + k_1 \cdot (1 - b + b \cdot \frac{|D|}{\text{avgdl}})},$$

where, $\text{IDF}(q_i)$ is the inverse document frequency,

f(qi,D) is the q_i's term frequency in the given document,

k_1 and b are free parameters with k_1 = [1.2, 2.0] and b = 0.75

|D| is the length of the document D and

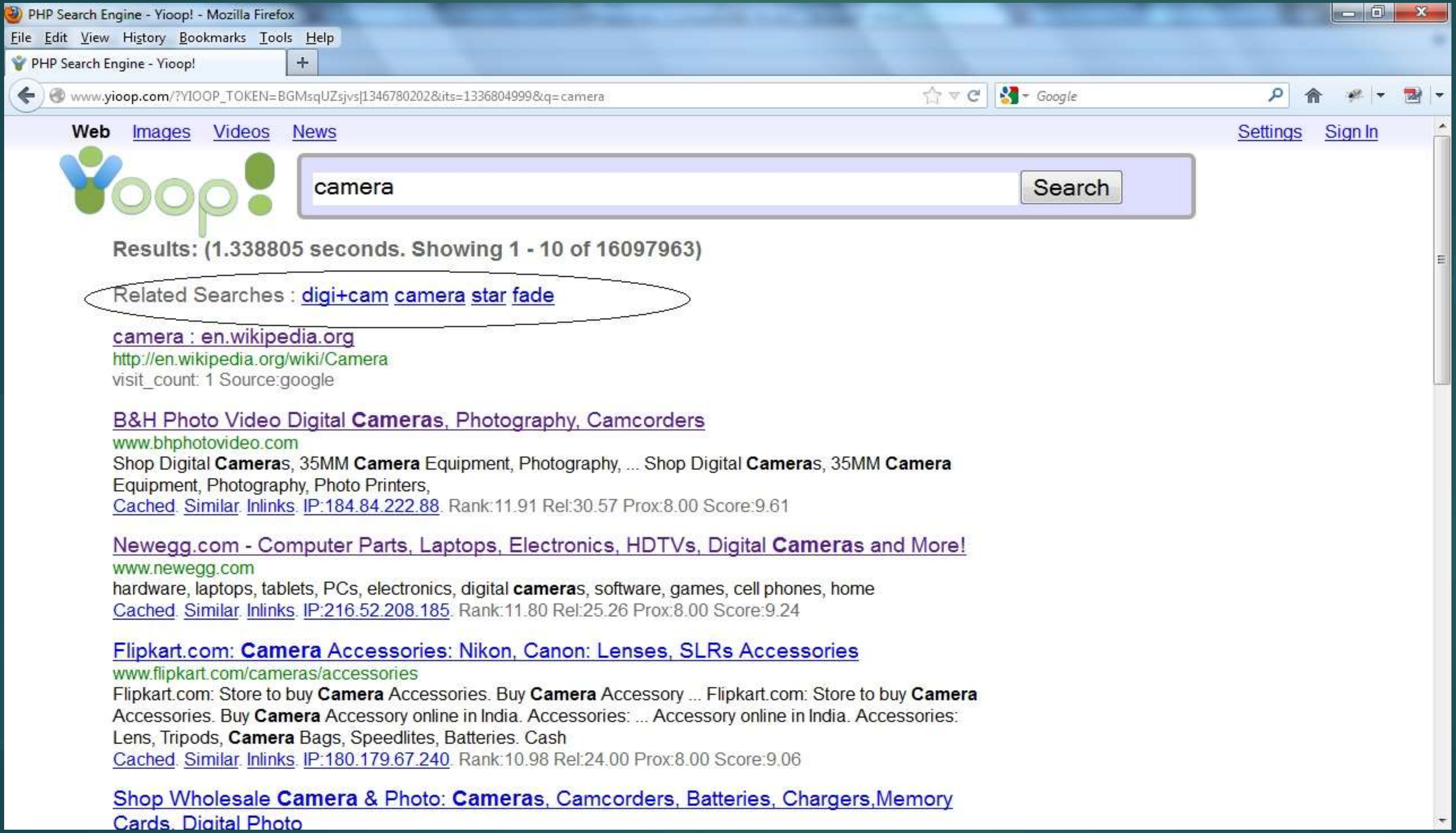
avgdl is the average document length

$$\text{IDF}(q_i) = \log \frac{N - n(q_i) + 0.5}{n(q_i) + 0.5},$$

where, N is the total number of documents and

$n(q_i)$ is the number of documents containing q_i.

Related Keyword result



Demo

Tests and Result

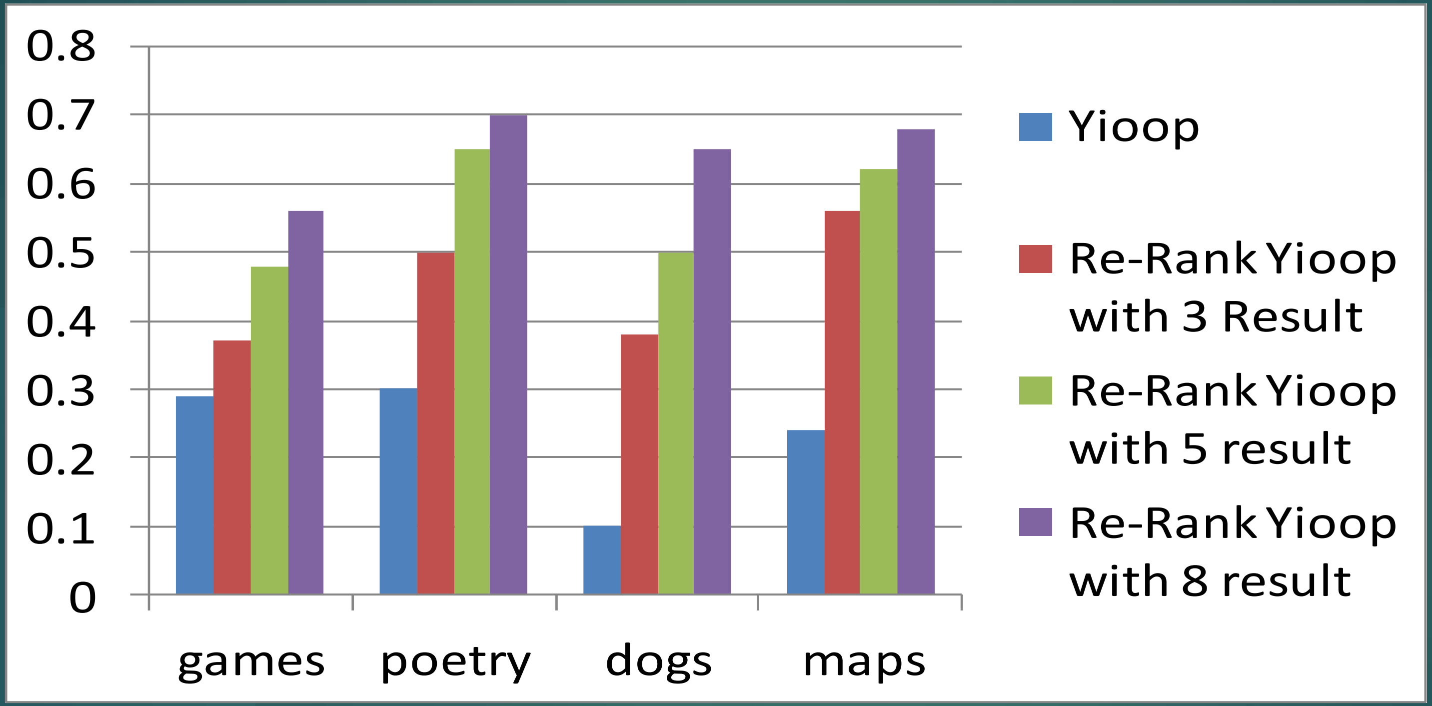
- Used feedback from five volunteers to test the re-rank feature and the related keyword feature

- Used the measure of Precision and Recall to calculate the effectiveness of the feature.
  - **Precision** is the fraction of the result set that are relevant

    Precision = $|Rel \cap Res| / |Res|$
  - **Recall** is the fraction of relevant documents that appear in the result set.

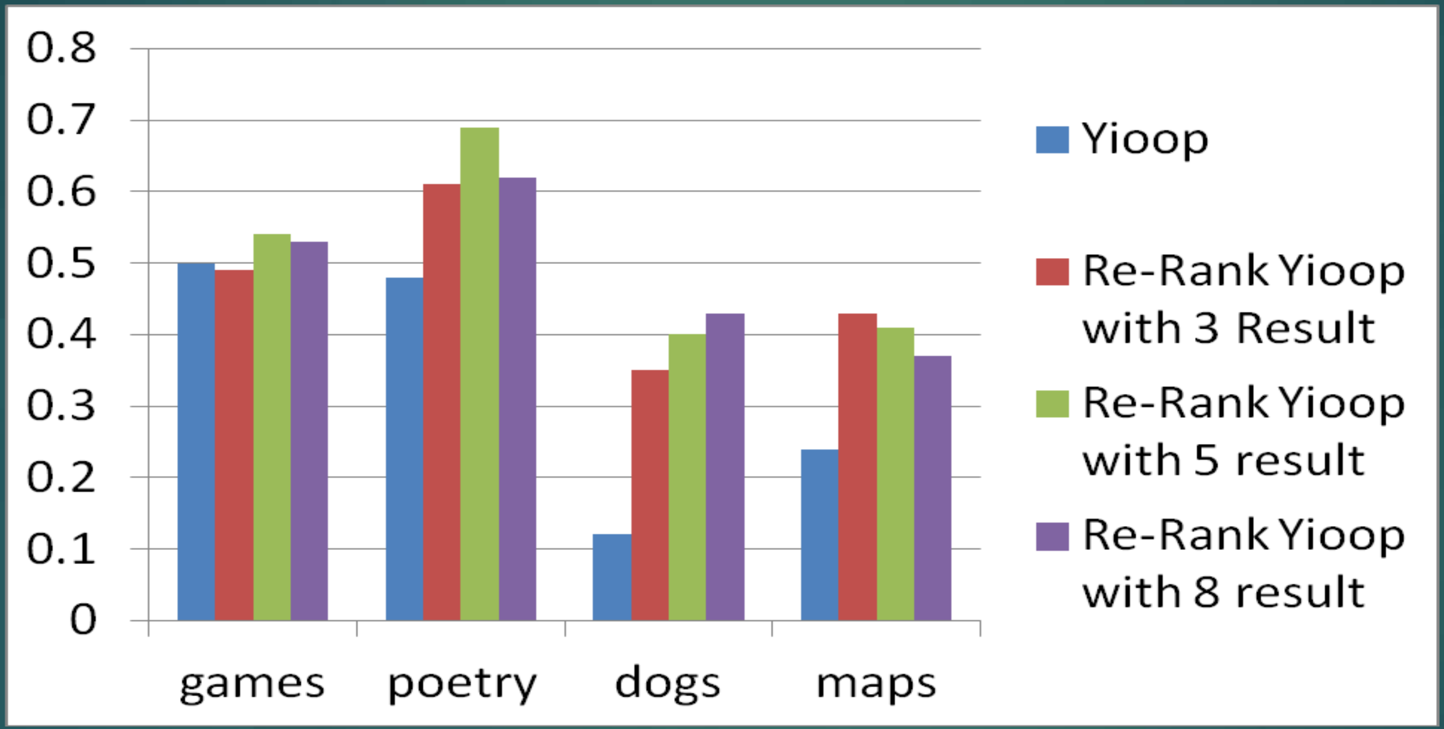
    Recall = $|Rel \cap Res| / |Rel|$

Re-rank result



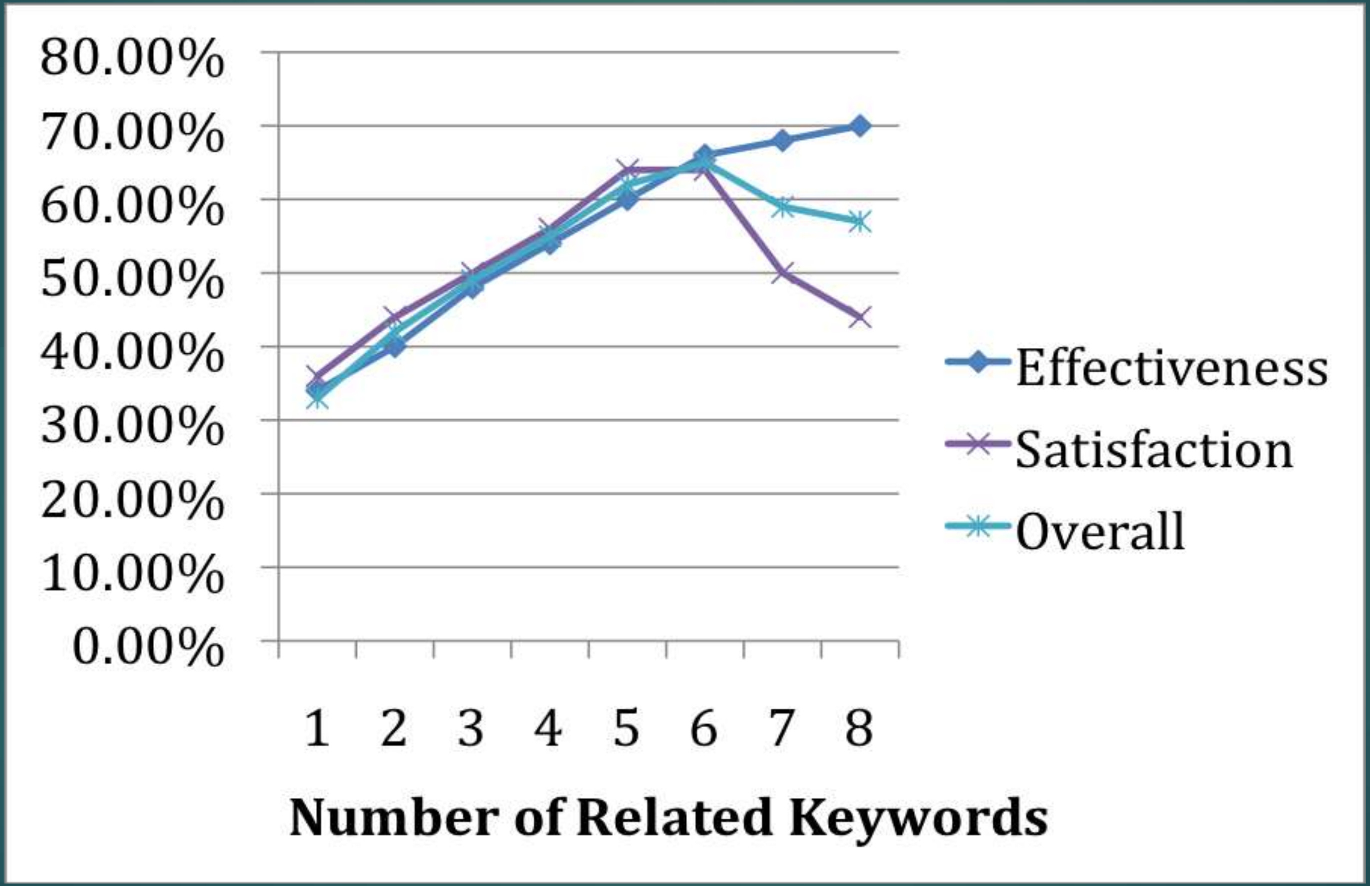
Recall comparison of Yioop and Re-Ranked Yioop Result

Re-rank result



Precision comparison of Yioop and Re-Ranked Yioop Result

Related keywords

- 

Conclusion

- The project improves the Yioop user experience by using the users past searches.
- The re-rank feature has improved the mean recall value from 0.23 to 0.56 when top 5 results are added.
- The re-rank feature has improved the mean precision value from 0.33 to 0.51 when top 5 results are added.
- The related keywords is most effective with the maximum of 6 relevant results.

Questions