The YouTube website search system evaluation report

Abstract

This report aims to evaluate an existing search system from the perspective of an expert. From several retrieval systems, the author selects the YouTube website to test but only assesses its search system rather than other tasks such as sharing or downloading videos. There are three main aspects the author will investigate: functionalities, effectiveness and usability. In addition, for every section, the author adopts most common and classical methods, including search user interface, mean reciprocal rank, discounted cumulative gain and 10 usability heuristics. (Wilson, 2011; Clough & Sanderson, 2013; Järvelin & Kekäläinen, 2002; Nielsen, 1995). Based on the results of these theories, it is argued that there are three strengths of YouTube website search system: few but practical system functionalities, effective rank algorithm and concise user interface. It is evident that, however, no expert search and poor misspelling processing are two major weaknesses. Facing these problems, the author, therefore, offers two suggestions: establishing YouTube professional edition and building navigation search menu. To conclude, the YouTube website search system is designed for general public and it can deal with most tasks well in daily use. Further work, however, needs to be done to meet expert users' need.

(Word Count: 3215)

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1. Description of YouTube search engine

YouTube is one of the most popular global video websites. One of the main reasons why a massive number of users use this video website might be that YouTube strongly encourages users to upload original videos. Its statement is to give everyone a voice and to show them the world. Most user groups on YouTube, therefore, are likely to be general public and it is evident that they would like to seek entertainment information for YouTuber's unique experience or story. Another information need is academic content which is shared on YouTube increasingly. According to Akgun et al. (2014), there are a substantial number of educational videos about electrocardiogram (i.e., the process of recording the electrical activity of the heart) can be found on YouTube website. Other studies report similar findings of the use of YouTube website in searching professional knowledge (Chen et al., 2013; Boyers, Quest, Karimkhani, Connett & Dellavalle, 2014). In regard to search tasks, Kellar, Watters and Shepherd (2006) hold the view that there are three main information seeking tasks: *fact-finding*, *information gathering* and *browsing*. They also claim that the aim of the first and second search task is to find a specific information and collect relevant information about a topic respectively.

It is clear that YouTube, as the second biggest search engine, succeeds in the first two tasks because of its excellent search features. In his study of search features, Wilson (2011) asserts that search user interface consists of *input*, *control*, *informational* and *personalisable* categories. In Appendix I, Table 1 lists these four groups with corresponding features of YouTube website and each purpose. It appears that, for the *input* group, YouTube website is concise. It only has three features but the accurate autocomplete feature and search video by URL address feature is very effective especially for video searching system. *Control* category includes several features, such as the sort and filter feature, which allow users to modify and restrict search results efficiently. Concerning *informational* group, there are five significant features which can provide various information about search results. For example, video preview (3s) and video thumbnail feature might be useful for researchers to evaluate videos approximately and recognise them rapidly. In terms of *personalisable* category, it can be seen that the aim of these features could be the convenience of the user in the future.

To sum up, the target audience of YouTube website are ordinary users and, on this website, the information need is likely to be entertainment as well as professional content. On the other hand, several search features of four categories, in Figure 1, strongly support fact-finding and

information gathering search task. The next section will describe two searching scenarios in detail and interpret how these features work.

2. Supporting the users' search process

Sutcliffe and Ennis (1998) offer a retrieval model and it is divided into four activities: identify problems, articulate needs, query formulation (reformulation), and result evaluation. Based on this theory, the author briefly describes two search tasks, *known-item search* and *search for instruction*, and then explores how search features can support retrieval process in the following two scenarios.

2.1 User A: known-item search

2.1.1 Description of search task

A football fan (user A) would like to review 2018 World Cup Final full match with friends on Saturday night and decides to search on YouTube website. They, however, do not remember the name of both team and score. According to Toms (2011), the user search for a specific information item which is known to exist, called *known-item search*. The initial need is to develop a query that will find the 2018 World Cup final full match, which is a *fact-finding*.

2.1.2 Supporting method

First, user A types ***World Cup*** in the search box but autocomplete feature gives guidance ***World Cup 2018***. Then, A accepts this advice because it is the right year he wants to search. After searching the first query ***World Cup 2018***, it returns several different matches but when evaluating results, user A does not know which the final match is. Next, user A types ***final match*** after the existing ***World Cup 2018*** and uses the filter feature to choose long duration (>20 minutes) because user A wants to watch the full match instead of the highlight video. To assess one possible right result, user A moves mouse pointer on video thumbnail and preview 3 seconds to assess it. Finally, user A confirms that the top one result is the 2018 World Cup Final full match video.

In this search process, the YouTube website uses following features to support user A in Figure 2.1. First, autocomplete help user complete integral query, ***World Cup 2018***. Second, filter feature allows user to narrow scope, focusing on the full match. Third, preview feature gives user additional information to evaluate result, confirming specific content of video.

2.2 User B: Search for instruction

2.2.1 Description of search task

The target of a statistic student user B is to find how to identify outliers in a group of data set. In his study, Toms (2011) claims that the user search for a specific explanation for how to achieve a successful outcome is called *search for instruction*. The initial need is to formulate a query to find a teaching video about recognising outlier, which is *information gathering*.

2.2.2 Supporting method

First, user B inputs ***outlier*** in the search box but results contain some music video. Then user B scans additional query given by autocomplete and chooses ***outliers statistic*** to search. When evaluating results, based on thumbnail and preview of several videos, user B finds that there are several different methods, but box plot is the easiest method. So, user B decides to add ***box plot*** after ***outliers statistic*** and it returns a number of expected teaching video. Finally, user B adds several videos into watch later.

In this search process, the YouTube website uses following features to support user B in Figure 2.2. First, autocomplete give user more specific suggestion to determine right query. Second, the thumbnail and preview feature provide the overview of results for user to assess. Third, the watch later feature allow user to save selected videos for later use.

2.3 Summary

In this section, the author briefly describes two search tasks including scenarios and queries, shown in Table 2 and discuss the effect of search features by using the process model of Sutcliffe and Ennis (1998). It is evident that these features are valid tools to support user during search process, but the effectiveness of overall website will be investigated in the next section.

3. Analysis of retrieval performance

The aim of this section is to assess the YouTube website retrieval performance. According to Rose and Levinson (2004), there are three main search goal categories: *navigational*, *informational* and *resource*. Bases these models, it is possible to test precision by using reciprocal rank for navigational task and judge relevance by discounted cumulative gain for informational or resource tasks. For the structure of this part, the first concern the introduction of appropriate methodology and the second is a description and explanation of the result.

3.1 Methodology

3.1.1 Mean reciprocal rank

According to Clough and Sanderson (2013), mean reciprocal rank (MRR) would be appropriate for navigational search goal, in which there is just one target information. The author, therefore, selected five different and popular topics on YouTube website and each known term is listed in Table 3.1. Another aspect is that there are four query types the author will score, corresponding search query also shown in the table, in order to test the ability to handle different types. For every query, the expected search results can be confirmed in preliminary searching. In the testing process, the author records reciprocal of the rank at which the first relevant document is retrieved and calculates MRR for every query type.

3.1.2 Discounted cumulative gain

Clough and Sanderson (2013) hold the view that a graded relevance assessment can adopt discounted cumulative gain (DCG). Based on this measure, the author gives a score to each piece of searching results, indicating relevance (e.g., 2 = highly relevant; 1 = partially relevant; 0 = not relevant). In addition, in another related study, Järvelin and Kekäläinen (2002) suggest that normalised discounted cumulative gain (nDCG) is likely to be more useful. The author, therefore, selects and runs popular search queries from Google Trends in 2017 on the YouTube website. Moreover, there are DCG and nDCG scores calculated and summarised in Table 3.4, on the basis of specific search result (Table 3.3)

3.2 Results

3.2.1 Precision

As introduced above, the aim of MRR is to assess the precision of YouTube website. The results of MRR score for four query types are presented in Table 3.2. From this figure, it can be seen that the ability to handle "*Plain language"* and "*Plurals and stemming query"* is

competent, whose MMR score are both 0.9. It is evident that, in contrast, searching for "*Synonym query"* is not so accurate but still effective, 0.72 MRR score. There is, however, a significant shortage when dealing with "*Misspelling query"*, of which MMR score is only 0.3. To sum up, for "*navigational"* search goal, the overall MRR score is 0.705. It is also argued that the precision of YouTube website can be effective for most of "*navigational"* query types, but '*Misspelling query"* needs to be improved.

3.2.2 Relevance rank

To assess relevance, the DCG and nDCG score of each query are presented in Table 3.3. From this figure, it is easy to find that "*obtain*" and "*directed-open*" search goal perform well, of which nDCG score is apparently high, 0.996 and 0.994 individually. There are, however, two search goals' nDCG score below 0.9, which suggests that YouTube website may be not good at dealing with these two goals: "*advice*" and "*locate*". A possible explanation is that the content of these two goals is fewer and the relevance rank is, therefore, not so effective. In brief, for "*informational"* and "*source"* search goal, the overall nDCG score is 0.940. It is also argued that the YouTube website can handle these types of query with excellent relevance rank.

3.3 Summary

In summary, using the test collection method, the author selects and runs different queries to assess precision and relevance rank. As can be seen from Table 3.3, there is a medium MMR score of overall system and it is suggested that the precision of YouTube website is medium level. In regard to relevance rank, the high mark of nDCG10 (0.94 of 1) indicates that the YouTube website can find relevant video effectively and provide more relevant video at a higher place in the result list. It is possible, however, that users may not prefer search systems with enhanced effectiveness due to the lack of usability (i.e., how easily the retrieval system can be used). Accordingly, the usability of YouTube system is assessed in the next section.

4. Analysis of usability

This section evaluates the usability of YouTube searching function. In his study, Nielsen (1995) claims that there are 10 general principles to investigate the usability of website or search engine. According to this, the author will test every heuristic and give a brief description including score, shown in Table 4. For the structure of this part, the first concern the introduction of methodology and the second is the description and explanation of result.

4.1 Methodology

As cited above, there are 10 usability heuristics could be used to assess usability. Other studies also maintain that these heuristics can be used to measure usability and identify how well the search system performs (Wilson 2011; Hearst 2009; Costabile & Buono 2012). The author, therefore, investigates and marks each of them from 1 to 10, the higher it marks, the better usability it has. When discussing results, the score is divided into three grades: high efficiency (10-8), medium efficiency (7-6), low efficiency (0-5). Moreover, it is possible to classify 10 heuristics into four categories based on heuristics similarity and here are results.

4.2 Results

The first category consists of two heuristics: "*Consistency and standards*"; "*Aesthetic and minimalist design*" and "*Match between system and the real world*". In the first two heuristics, Wilson (2011) makes a valid point, in that he argues that reasonable application of white space can balance the number of contents being shown. In addition, every web page of website should follow this compact and same design style. When surfing the YouTube website, it is not difficult to find that every searching result uses a similar style to display metadata, such as uploader, viewing count, upload date. The white background, as well as appropriate image size can give searchers a concise using environment. Regarding to "*Match between system and the real world*", YouTube website use users' common language and it is easy to understand, but there are several small flaws. For example, most users could not distinguish channel with programme when filtering video type.

In regard to the second category, there are three heuristics: "*Help users recognise, diagnose, and recover from errors*"; "*Help and documentation*" and "*Error prevention*". Nielsen (1995) argues that the aim of these is to help user avoid errors and give several suggestions if it still happens. Consequently, YouTube website provide autocomplete suggestion and no founds

advice for novice. There is not, nonetheless, much useful information about retrieval system in help page.

The third category includes "*Visibility of system status*" and "*Recognition rather than recall*". According to Costabile and Buono (2012), the aim of "*Visibility of system status*" is to provide additional information on what is happening now and the system operations. For the YouTube website, there is a merit: it shows the search box and keywords all the time to tell users what they are searching. The filter bar, however, always folds automatically, which can cause users to forget what whey choose for filter. In terms of "*Recognition rather than recall*", there is an obvious shortcoming for YouTube retrieval system: no category navigation menu. Hearst (2009) holds the view that a category system is useful for organising searching results. It also helps users recognise and select a specific category rather than to recall it. Another small weakness point is that there is no feedback or sign for previously seen videos. The recognisable thumbnail, nevertheless, compensates this shortage because it might be easy for users to recognise whether this video has been watched or not.

Concerning the last category, in her study, Hearst (2009) points out that there are two features to support "*User control and freedom*" heuristic: customise search results rank and query transformation. The YouTube website, for instance, can change rank sort by relevance, upload date and so on. In addition, user can also choose "*search instead for*" to continue searching uncommon query. The major problem of YouTube website, however, is "*Flexibility and efficiency of use*". This is because there is no any expert function in YouTube searching system, which is considered as a significant function for expert user (Wilson, 2011). Restricted mode, nonetheless, can provide limited flexibility for video retrieval.

4.3 Summary

Overall, it is evident that almost all of heuristics (9 of 10) score higher than 6 points (i.e. belonging to medium efficiency and high efficiency). As Table 4 shows, "*Consistency and standards*" and "*Aesthetic and minimalist design*" reach highest score (9 of 10 points), which indicates that user interface of retrieval system is very simple and easy to use, especially for novice user. What is striking about the figures in this table is "*Flexibility and efficiency of use*", which is the only one heuristic with low efficiency. This is because YouTube might not offer an advance search for expert user, but suggestions for improvement will be given in the next section. In addition, according to Costabile and Buono (2012), the limitation of this approach

is that today, user satisfaction is not only related to usability, but also focus further on user experience including pleasure, aesthetics and fun.

5. Discussion and recommendations

5.1 Discussion

The findings of this report have indicated that there are several different perspectives to evaluate a retrieval system: search functionalities, search effectiveness and usability of system. In the final section, the aim is to highlight the main strengths and weaknesses using test results in the table, make recommendations for the YouTube website and draw a conclusion.

5.1.1 Strength

The first strength is the few but practical system functionalities. As shown in the Table 1, there are a relatively small number of features in the YouTube search system. The results of the second section, Supporting the users' search process, suggests many features could assist user to prevent error, narrow results scope and assess searching results, such as "Autocomplete", "Filter" and "Video preview".

From the Table 3.3, it is clear that another merit is the rank algorithm. According to Resnick and Vaughan (2011), it is crucial that users rarely have enough patience to scroll too many times. The high mark of overall nDCG (0.94 of 1) indicates that the rank algorithm of YouTube search system successfully ranks most relevant information at the top of results page. It prefers to load results page by page instead of showing at one time.

Moreover, what is also worth noticing is the excellent user interface, "of which the dimensions and layout are clear and intuitive to the searcher" (Wilson, 2011, p.101). Apart from these strength point, there are also several weaknesses which need to be overcome.

5.1.2 Weakness

As discussed in the previous heuristics evaluation, the biggest problem of YouTube system is that there is no expert search, which may be seen as an effective method for expert user to search (Wilson, 2011). A possible explanation for the lack of this is that most user of YouTube website is general public, for whom the simple search is enough. It is also argued that complicated advance search can have impacts on their user experience. The increasing number of expert users can make this problem more serious.

Another weakness is the ability to deal with misspelling query. As Table 3.2 shows, there is a significant gap of MMR score between Misspelling and other query types, which is well below.

Facing these problems, the author, therefore, offers the following suggestions in order to improve the system and meet the needs of users.

5.2 Recommendation

The first suggestion is to establish a YouTube professional edition. Google Scholar, for example, is an effective professional search website for scholar literature. Similarly, it is possible for the YouTube website to gather academic or teaching videos together. In addition, this professional edition can provide a real advance search for expert user to accelerate searching efficacy, which could eliminate the first weakness.

Building a navigation menu is another recommendation. It is generally acknowledged that there are many types of video for different topics, such as music, technology, movie and so forth. The current menu of YouTube website, however, is only used for browsing instead of searching. According to Hearst (2009), a classified search could assist user to select video from specific category. It is, however, evident that classifying videos by topics is challenging because many videos involve a wide range of different topics.

To conclude, it is evident that the YouTube website search system can complete most common users' tasks effectively. The improvement of YouTube website, however, is to meet expert users' need.

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Appendix I

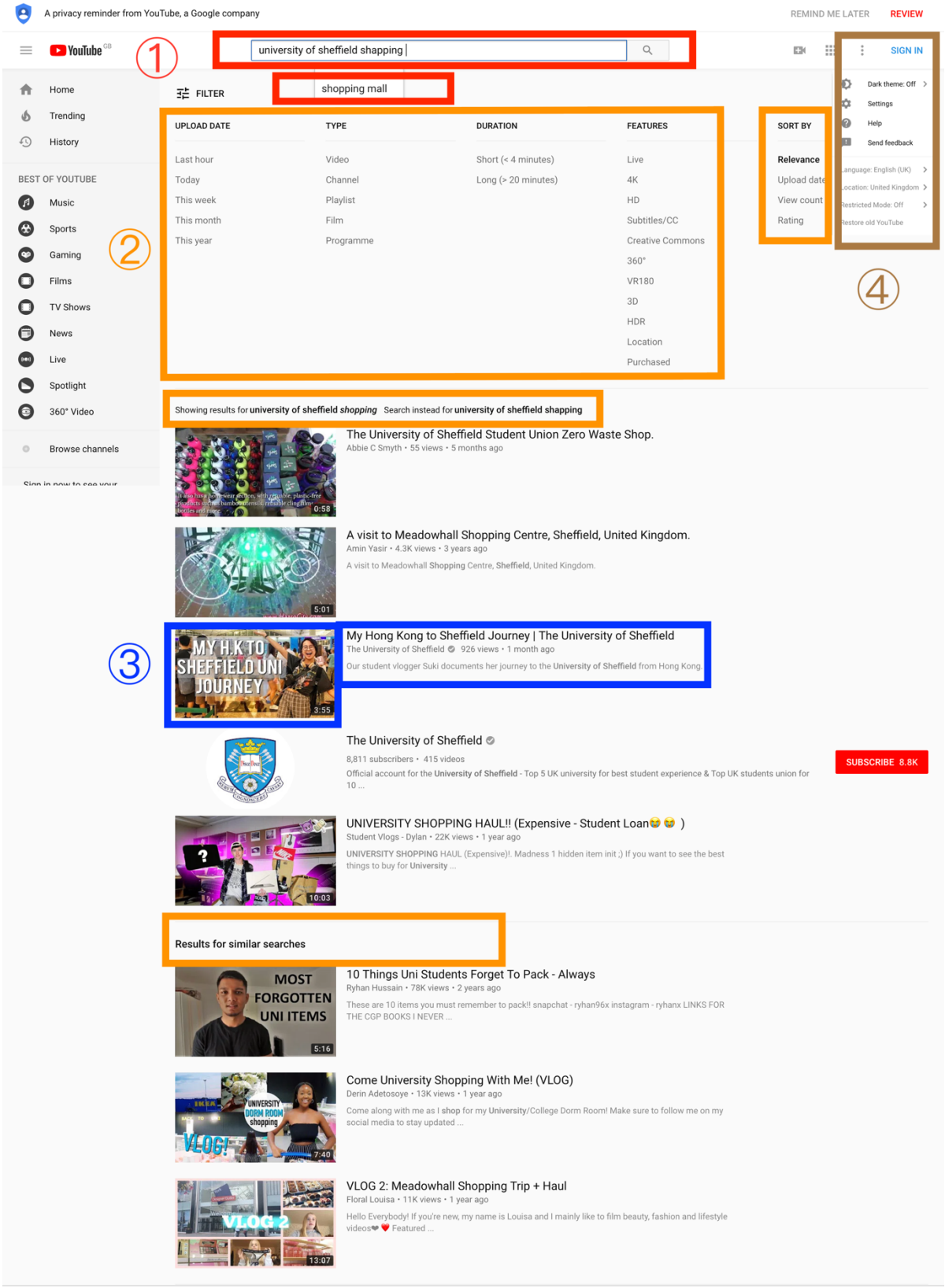

Figure 1: There are four feature categories: Input as Red (①), Control as Orange (②), Informational as blue (③), and Personalisable as brown (④).

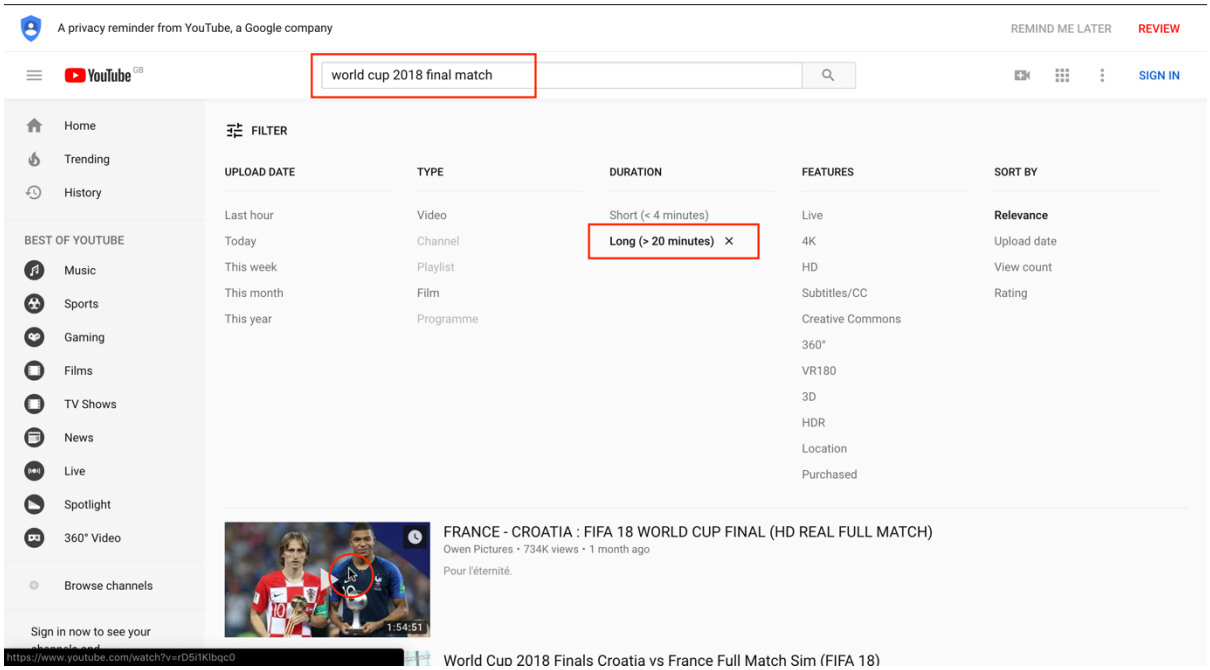

Figure 2.1

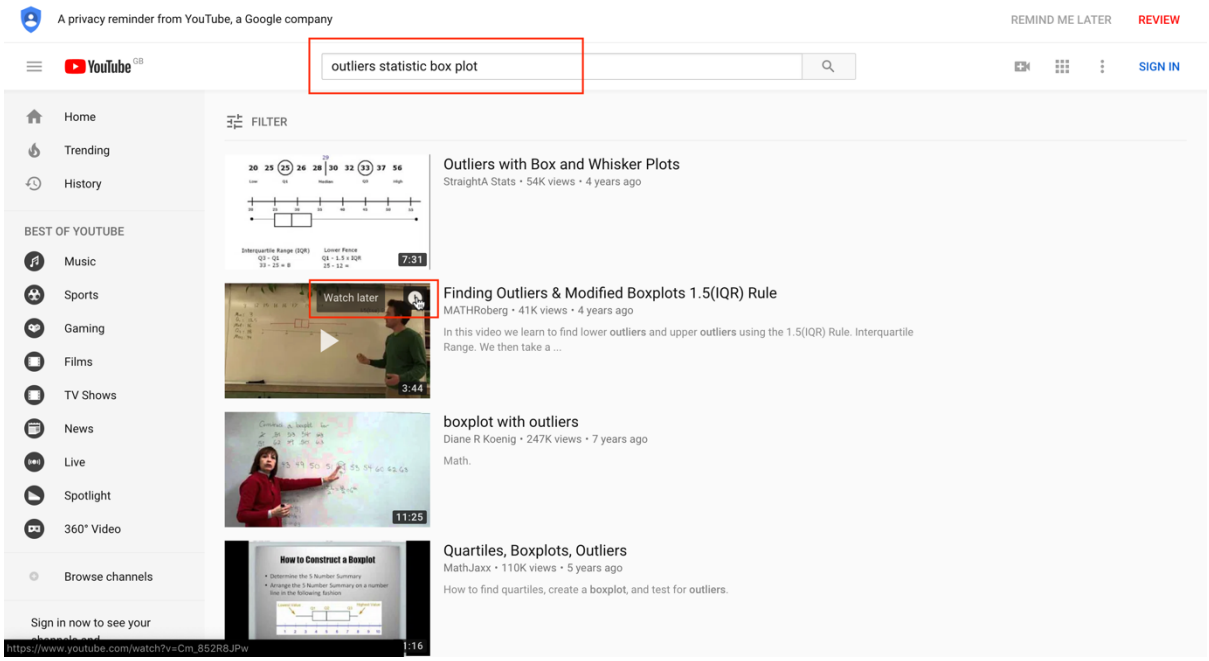

Figure 2.2

Appendix II

Table 1

Category	Feature	Purpose
Input	Search Box	Input basic search queries
	Auto Complete	Give guidance towards queries that are likely to work
	Search by Link Address	Allow users to find a specific item quickly
Control	Results for Similar Search	Suggest similar search results to the searcher that might be more precise
	Correction	Avoid query mistakes
	Sort	Change order of results
	Filter	Affect display of results
Informational	Video Thumbnail	Help users recognize video more quickly
	Video Preview (3s)	Allow searchers to see additional information when making a decision about a search result
	Basic information	Display video's title, description, author, upload date, view count
	Usable information	Allow users to mark video and watch later
	Snippet	Inform users whether this video is new or has subtitle
Personalisable	Watch History	Allow users to return to previous search results that they thought was useful
	Watch List	Allow users to save videos
	Language	Help users to set up default language
	Restricted Mode	Avoid inappropriate content
	Recommendation	Recommend videos or channels based on users' watch or search history

Table 2

Search task	Scenario	Query
Fact finding task: known item research	A football fan would like to review 2018 world cup final full match but forget the name of both team and score.	World Cup 2018
		World Cup 2018 final match
Information gathering: Search for instruction	Student B meet problems on analysing outlier data and aim to find teaching video about how to identify outliers in group of data set	Outlier
		Outliers statistic
		Outliers statistic box plot

Table 3.1

Search Goal	Known item	Query type	Search terms	Reciprocal
Navigational	Music song: Shape of you [official video]	A-Plain language	Shape of you	1/1 = 1
		B-Misspellings	**Sheep** of you	1/1 = 1
		C-Synonyms	**Body** of you	1/1 = 1
		D-Plurals and stemming	**Shapes** of your	1/1 = 1
	Sports game: 2018 Wimbledon final match	A-Plain language	2018 Wimbledon final match	1/1 = 1
		B-Misspellings	2018 **Wembliden** final match	1/1 = 1
		C-Synonyms	2018 Wimbledon **last race**	1/3 = 0.3
		D-Plurals and stemming	2018 Wimbledon **finally matches**	1/1 = 1
	Movie trailer: Fantastic Beats 2 final trailer	A-Plain language	Fantastic Beasts 2 final trailer	1/2 = 0.5
		B-Misspellings	Fantastic **Beats** 2 final trailer	1/2 = 0.5
		C-Synonyms	Excellent Beasts 2 final **trailer**	1/3 = 0.3
		D-Plurals and stemming	**fancy** Beast 2 final trailer	1/2 = 0.5
	Advert: marks & spencer christmas advert 2018	A-Plain language	marks & spencer christmas advert 2018	1/1 = 1
		B-Misspellings	marks & spencer christmas **advent** 2018	1/4 = 0.25
		C-Synonyms	marks & spencer **Xmas** advert 2018	1/1 = 1
		D-Plurals and stemming	marks & spencer christmas **advertisement** 2018	1/1 = 1
	Academic: Talks about “Weapons of math destruction”	A-Plain language	weapons of math destruction talk	1/1 = 1
		B-Misspellings	weapons of **mass** destruction talk	0
		C-Synonyms	**arms** of mathematics **ruin** talk	1/1 = 1
		D-Plurals and stemming	weapon of math **destruct talks**	1/1 = 1

Table 3.2

	Music	Advert	Sports	Academic	Movie	Mean Reciprocal rank score of query type
A-Plain language	1	1	1	1	0.5	0.9
B-Misspelling	1	0.25	1	0	0.5	0.45
C-Synonyms	1	1	0.3	1	0.3	0.72
D-Plurals and stemming	1	1	1	1	0.5	0.9
Overall						0.74

Table 3.3

Search goal		Search query	nDCG10
Informational	a. Directed-closed	"What is a hung parliament"	0.965
	b. Directed-open	"iPhone 8 review"	0.994
	c. Undirected	"Hurricane Irma"	0.936
	d. Advice	"How to stay young"	0.873
	e. Locate	"Best restaurant in London"	0.880
Resource	f. Entertainment	"Meghan Markle"	0.935
	g. Obtain	"Chilli con carne"	0.996
Overall			0.940

Table 3.4

a. Query - “What is a hung parliament”												
i	1	2	3	4	5	6	7	8	9	10	$DCG_{10} = 10.140$	$IDCG_{10} = 10.508$
rel_i	3	3	3	1	3	0	1	2	3	1	**$nDCG_{10} = 0.965$**	
b. Query - “iPhone 8 review”												
i	1	2	3	4	5	6	7	8	9	10	$DCG_{10} = 12.684$	$IDCG_{10} = 12.763$
rel_i	3	3	3	3	3	3	3	0	3	3	**$nDCG_{10} = 0.994$**	
c. Query - “Hurricane Irma”												
i	1	2	3	4	5	6	7	8	9	10	$DCG_{10} = 8.596$	$IDCG_{10} = 9.182$
rel_i	2	3	1	2	2	2	1	2	2	1	**$nDCG_{10} = 0.936$**	
d. Query - “How to stay young”												
i	1	2	3	4	5	6	7	8	9	10	$DCG_{10} = 9.205$	$IDCG_{10} = 10.540$
rel_i	2	3	0	3	3	2	1	3	0	3	**$nDCG_{10} = 0.873$**	
e. Query - “Best restaurant in London”												
i	1	2	3	4	5	6	7	8	9	10	$DCG_{10} = 7.872$	$IDCG_{10} = 8.947$
rel_i	3	1	1	1	2	0	3	3	1	1	**$nDCG_{10} = 0.880$**	
f. Query - “Meghan Markle”												
i	1	2	3	4	5	6	7	8	9	10	$DCG_{10} = 11.918$	$IDCG_{10} = 12.752$
rel_i	2	3	3	3	3	1	3	3	3	3	**$nDCG_{10} = 0.935$**	
g. Query - “Chilli con carne”												
i	1	2	3	4	5	6	7	8	9	10	$DCG_{10} = 13.000$	$IDCG_{10} = 13.053$
rel_i	3	3	3	3	3	3	3	1	3	3	**$nDCG_{10} = 0.996$**	

Table 4

Nielsen heuristic		Description		Score
		Merit	Shortcoming	
a.	Consistency and standards	A standard set of metadata		9
	Aesthetic and minimalist design	Suitable white background		9
	Match between system and the real world	Easy-to-understand language	Confused Channel and Programme type	8
b.	Error prevention	Offer auto complete suggestion Preview results	Misspelling is not good enough	8
	Help users recognize, diagnose, and recover from errors	No founds suggestion		7
	Help and documentation	General help page		7
c.	Visibility of system status	Search box always shows	Filter bar folds every time	7
	Recognition rather than recall	Recognizable thumbnails	No menu navigation No already watched feedback	6
d.	User control and freedom	Search instead for Rank order Query Transformations		6
	Flexibility and efficiency of use	Restricted mode	No any expert function	5