Efficiently Discovered Deep Web Interface Using Data Mining Approach

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Abstract— **the content hidden behind HTML forms, has long been Recognized as a significant gap in search engine coverage. It represents required contents of the data on the Web; accessing Deep-Web content is not an easy challenge for the database community. Indexing of the searched data is fundamental problem faced by web crawlers that has profound effect on search engine efficiency. Recent study about searching contents on the web shows that nearly 96% of data over internet is encapsulated as well as hidden i.e. not found to search engines. The challenge faced by the search engines is to retrieve and access hidden web data or contents at low cost. This composed system uses a machine learning approach that is highly scalable, completely automatic, and very efficient to use, that helps to improve data retrieval functionality at lower cost. This system uses focused crawling strategy for accessing accurate searched results related to query and selects only relevant information or data according to their similarity with respect to query. The algorithm used in this system intelligently selects only possible candidates rather than searching whole document for addition in too your web search index. The automatic attribute building is used for form classification that helps to minimize manual training time and data set building.**

Index Terms— **Deep web; Web Crawler; Form Focused Crawler.**

I. INTRODUCTION

This Recent days web search engines do not capable to index and search a major portion of the Web hence, the web users unable to discover a large amount of information from the non-indexable part of the Web. In particular, dynamic pages generated based on parameters provided by a user via web interfaces are non-indexed by search engines. This is the key challenge to found in recognize the resulting web pages without submitting parameters to the web form. Traditional web search engines are able to index only a selected portion of the Web. The web, which is badly indexed by search engines, is not only the part of deep web. Deep web [16], also contains the web pages which is never get register into the WWW and the web pages that contains form on it which do not able to index by the traditional crawling approach.

The hidden Web also include the dynamic data provide by web applications which returns real-time information after accepting particular user request like the online shopping or ticket booking systems. Depending on issued the request at each time the different result will be generated. Even though, these websites may provide a link structure to the items in database to perform crawling by the crawlers designed for the surface web. But there is no guarantee that those search engines will have the updated and current information about prices and remaining items in stock. Naturally this significant portion of the Web containing information in the form of electronic web is poorly accessible by conventional web crawlers designed for general purpose search engines.

Web Crawler continuously downloads web pages and indexed them, after indexing stored in database [2]. Search engines use an automated tool called web crawler to collect web pages to be indexed. The web crawler initially starts with a list of URLs to visit called the seeds set (candidate sites) and as the crawler processes these URLs, it extracts all hyperlinks from visited web pages and insert them to the crawl frontier contains the list of URLs to visit. According to the crawlers rules set, the URL's from the crawl frontier are recursively visited. The web pages which URL's are not added to search engines indices are neither in the seeds set nor in the crawl frontier.

The crawler which crawl only web pages related to specific domain then it is called as focused crawler [2]. The web pages which are not associated to the particular domain are not measured. A crawler which fetches all searchable form without focusing on a specific topic is called a generic crawler [1]. Form focused crawler can automatically discovers the searchable web interfaces on a specific topic [1].

II. LITERATURE SURVEY

In our daily life Search engine web sites are the most significant part to visit in internet worldwide. In the entire World Wide Web (WWW) for searching any content by using search engine web crawler leads an important function. Standard approach of crawler for traversing the web is long-lasting in terms of resource usage on both client and server. Thus, to collect the most relevant pages, the majority of the researchers focus on the structural design of the algorithms that are associated with topic of interest. The topic specific web page crawling indicates the focused crawling was introduced by [15]. To discover the links which are most relevant by minimizing the irrelevant search of the web the focused web crawler approach [2] is used.

Liu et al [10][7], addressed focused web crawler based on Hidden Markov Model (HMM) crawler for identifying relevant pages paths. The new approach introduced by Liu et al [7] to addressed the problem of sequential pattern detection, they uses Maximum Entropy Markov Model (MEMM) to improve the features of focused web crawler. In this they use combination of link structure and content analysis approach [9], to capture sequential patterns leading to targets. The prediction overhead of hop distance is the problem associated with this system. To overcome the earlier problems they proposed [6], the probabilistic approach for

Manuscript received July 09, 2018

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capturing sequential patterns of pages associated to their domain by using HMM, MEMM and CRF (conditional random fields) based models. It improves the relevant set of pages but the computational overheads are high.

Karkaletsis et al [13], introduce a CROSSMARC focused web crawler for identifying domain specific web sites. They use a site specific spidering approach and reduce development and deployment overhead. But it is critical to customize the crawler for new domain as well as for new language. Yeye et al [5], introduce crawling of an entity oriented sites using empty page filtering, URL deduplication and query generation strategies to return the entity relevant links. But the system does not support multiple input fields for searching relevant pages. Batsakis et al [8], presents a strategies to improve the performance of focused crawler. They studies the several different approach to focused web crawlers evaluated using HMM crawler with the page content similarity and anchor text similarity. It is necessary that the input query must be well formulated.

Rungsawang et al [12], presents a learnable topic specific web crawler for discovering efficient result of web pages. For achieving this goal they keep the log of previous crawling to build some knowledge bases: seed URL's, topic keywords, URL prediction. The ability of learning tendency of crawler between the successive crawling is the most challenging task. Suel et al [14], implementing high performance distributed web crawler in order to achieve high performance at reasonable cost. This system mainly introduced to address the problem of system crashes, performance bottlenecks. They use breadth first search crawler strategy. The hardware cost is high and configuration setup overheads are there. David et al [11], describes the system for surfacing deep web content by using the incremental search for informative query templates (ISIT) algorithm. The main aim is to index the content behind the millions of HTML forms by identifying the input values of a specific type. This system is capable of handling form powered by HTML language only.

Abdul Nabi et al [4]. Introduced domain based information system which crawls related to specific domain. It improves the performance of the system by reducing the searching space and searching time. It use pattern matching algorithm to rank the web page and then total rank is calculated. The introduced system is requires the large number of collection from the specific domain. Feng Zhao et al [1], introduced a Smart Crawler with a two stage approach for efficiently harvesting deep web interfaces. They use adaptive link ranking, reverse search techniques. But the classifier required manual training for each domain by downloading the domain related form to train it.

III. OBJECTIVES

The main objectives of this paper are relevant document extraction from hidden deep web, which is impossible to search using standard crawling approaches; also the aim is to increase accuracy of deep web interface extraction by proposing self-attribute building approach for crawler. The key objective of our scheme is to minimizing irrelevant document extraction and searching while determining the relevant interfaces.

IV. IMPLEMENTATION DETAIL

A. *System Architecture*

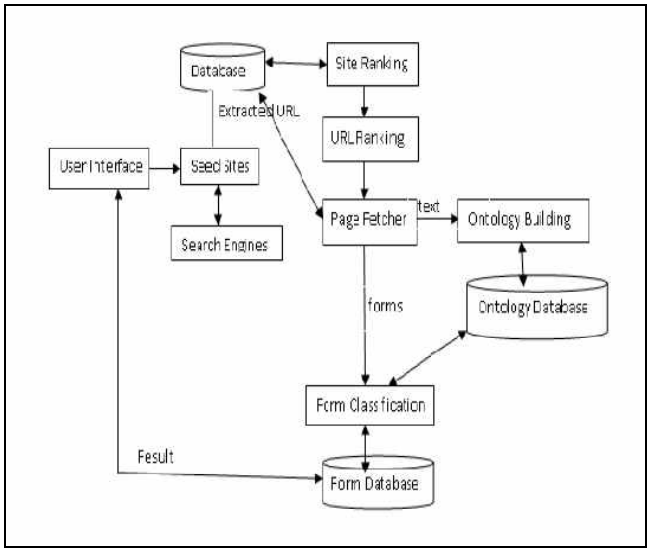

Fig. 1. Architecture of the System

To efficiently discover the deep web interfaces, proposed system is designed with the four major parts which are site classifier, site ranking, URL ranking and form attribute builder. The user can submit their query to the user interface and get result back with relevant pages on the same which is design by using the HTML. Specially, the crawling process starts with seed sites [1]. The candidate sites for crawler to start crawling are called a seed sites. The main aim is to minimize the number of visited URL's and at the same time maximize the deep web sites in seed sites. To achieve these goals system can takes help from different search engines to get website URL's on given topic. After collecting seed sites in site database the site ranker fetches the URL from it and ranks them by using site similarity and site frequency measures. In site similarity, the similarity of related features between new website ***s*** and the known deep web sites is measured. The site frequency measures the number of times a site appears in the known deep web sites than the other sites. Relevant sites then proceed for the URL ranking.

For ranking the promising link URL crawler automatically learn pattern of URL and identify their focus as crawl progresses. The page fetcher downloads the page after URL ranking and forwards them to attribute builder. In this system, the attributes can be extracting automatically by using the users viewpoint and the programmer viewpoint (web application). The final attribute set can be built by reconciling the results obtained from both ways with the help of ontology.

1) Attribute Bulider

The attribute names are extracted from HTML document. As most of the HTML tag consist of "name" attribute, which are perticulary useful for servlet side scripts like servlet for extracting parameter values, except such tag must be in between <form> and </form> tag and form must be submitted to the server. But, here we will not consider, as what matters

us is that we must extract required attribute name from form and use them to build automatic attributes.

```
<FORM action= "..." method= "...">
<P><LABEL for "departure_city">Departure<BR>
</LABEL>
<SELECT size= "2" name= "depart_city">
<OPTION selected value= "cityl">Newark</OPTION>
<OPTION>Arlington</OPTION></SELECT><P>
Where is your departure city? <BR>
<INPUT type= "text" id= "origin"><P> Search by:<BR>
<INPUT type= "radio" name="searchBy" value="fare"> fare<BR>
<INPUT type="radio" name="searchBy" value= "schedule"> schedule<P>
<INPUT type= "submit" value= "Go"> </P> </FORM>
```

Fig 2. Sample HTML form

For eg. HTML code is shown in Figure 2, which contains several tags with name, value pairs attributes. The <SELECT> tag having programmatical name "depart_city", where as user view point attribute text contains "Newark" and "Arlington". The programmer viewpoint attributes can be used for categorizing relevant forms from irrelevant froms.

--Algorithm 1.1: Inner Identifier Separation

Input: Data Sources DS_1, DS_2, … DS_n
Output: set IICA

1. delete duplicated IID from set S .
2. **for each** inner identifier in *S* **do begin**
3. **if** inner identifier contains special symbols **then** separate IID into several parts by spitting it using special symbol location;
4. **if** obtained identifier contains Capital letter **then** **break** identifier into two parts according to Capital letter location.
5. **for each** sub-string **do begin**
6. **for each** keyword of key **do begin**
7. **if** the keyword is located in the identifier **then** **break** each identifier into several sub-strings wrt keyword;
8. **end if**
9. **end for**
10. obtain IID which is a string containing several sub-strings
11. **end**
12. **for each** separated IID **do begin**
13. count the number of sub-strings, ss, in the separated IID
14. **for** index i = 1 to ss **do**
15. extract a string which is composed of s consecutive words from the sorted IID, and add the string into the set IICA, ;
16. **endfor**
17. **end for**
18. Remove the duplicated strings in IICAi ;
19. **return** IICAi
20. **end**

The free text is the text between the any two HTML tags and it is consider while extracting User View Point Attributes. Each textual element is mapped into Focus Term Candidate Attribute (FTCA). Algorithm 1.2 describes procedure to obtain set of User View Point Attributes.

Algorithm 1.2: Extracting User View Point Attributes

Input: Data Source DS_1, DS_2, … DS_n
Output: UVA set

1. Remove all the text between <option> and </option> from HTML Forms, .
2. Extract free text between two HTML tags from HTML Form, and add each textual word into FTCAi Set.
3. **foreach** word in FTCAi set **do begin**
4. **if** a word contains special symbols **then**
5. divide such word into sub parts wrt special symbo, and add each part into FTCA
6. **Add** copy FTCAs set into UVAi set
7. **end**
8. **return** UVAi

About more than 166,000 words where found in the WordNet. It is a lexical ontology. Each word consists of a string with its corresponding meaning. In this paper, WordNet is usedvfor finding alternates of PVAs and UVAs and for eliminating stop words. Which helps in retrieving a correct attribute. Obtaining the synonym for each candidate attribute of PVA or UVAi is shown in algorithm 1.3. where SCA indicates the synonym of candidate attribute.

Algorithm 1.3: Obtaining Synonyms of PVA or UVA

Input: IICA, UVA, PVA
Output: SOUVA, SOPVA

1. **for**each attribute from PVA or UVAi do
2. Set SCA to be an empty string
3. **if** the candidate attribute (CA) contains more than one sub words **then**
4. **for each** sub-word in the CA **do**
5. **if** (sub-string has meaning in WordNet) or (the sub-string has an adverb phrase in WordNet) **then**
6. add the simple format of sub-word into SCA;
7. **if** SCA is not an empty string **then**
8. add one row into SOPVA or SOUVA, with the format of SCA # SCA
9. **end**
10. **else**
11. **if** (candidate attribute has a noun meaning in WordNet) **or** (the sub-word has a adverb phrase in WordNet) **then**
12. **if** CA is plural **then**
13. **replace** the CA by its singular format

14. choose all synonym of the first sense of the CA from WordNet to form SCA, add one row into SOPVA or SOUVAi with the format of CA # SCA
15. **end**
16. **end**

The Final Attribute set can be made by comparing the SOUVA with UVA and SOPVA with PVA and finally comparing the results of previous two comparisons. In which, the UVA set mapped to appropriate PVA, as shown in Algorithm 1.4.

Algorithm 1.4: Final Attribute Extraction

Input: SOUVA, UVA, PVA
Output: FA

1. **for each** row in SOUVAi do
2. Obtain the target UVA
3. Continue = True
4. **for each** row in SOPVA do
5. Obtain the corresponding target PVA
6. **if** the target PVA is a sub-string of the target UVA **then**
7. **if** (the length of the PVA >= a % of the length of target UVA) **then**
8. Add the target UVA to FAi set; **break;**
9. **end**
10. **if** one of the synonyms of the target PVA is same to one of the synonyms of the target UVA **then** begin
11. **Add** the target UVA to FA, set; **break;**
12. **end**
13. **end**

2) Form Extraction

If the extracted web pages contain a form then it can be cross checked using attributes extracted from the attribute extraction module for given topic. If the attributes can be found in the extracted form then such form is classified as relevant form and stored in database for future reference

B. Results

This system is developed in java and module tests were conducted on intel core 2 duo having 512MB RAM. The user can submit their query on to interface provided by system. The system is divided into three parts one is Automatic Attribute Extraction algorithm, user interface, reverse searching for deep web interfaces, page raking, form classification.

The reverse search module uses google search engine API for throwing search search queries to search engines and getting candidate URLs. The table I given below shows execution of reverse searching module and number of results obtained.

TABLE I. REVERSE SEARCHING RESULTS

Sr No	Query	No of Results Obtained online	Deep Web Data Sources
1	Books	3,48,00,00,000	9
2	Airfare	28,60,00,000	19
3	Movies	4,41,00,000	29
4	Jobs	1,65,00,00,000	30

In order to examine the effectiveness of attributes the automatic attribute extraction (AAE) algorithm extracted. The attributes are automatically obtained by the AAE algorithm after applying it over Deep web data sources documents. The downloaded deep web data sources from URIC Web integration repository (Chang et al., 2003) contains 477 Web data sources catagorized into 8 domains, hotels (39), airfares (49 documents), jobs (52), automobiles (97), books (67), car rentals (25), movies (78) and movies (78). In each data source there are 3 query interfaces. The seven test queries used in this dissertation are from Kabra et al.'s work (2005)[17], as follows:

Query 1 (from, to, departure date, return date)
Query 2 (author, title, ISBN)
Query 3 (make, model, price)
Query 4 (song, album, artist)
Query 5 (title, actor, director)
Query 6 (from, to)
Query 7 (from, to, adult, child)

TABLE II. AAE SUMMARY

Sr No	No of documents retuned	No. of releveant documents
Query1 (Airfare)	30	24
Query 2 (Books)	34	21
Query5 (movies)	35	28

The experimental evaluation for reverse searching and Automatic attrubute extraction shows that, automatic attrbute extraction efficiently extracts attributes from form interfaces, which can be used for identifying relevant forms, The remaining module will be integrated with these modules for overall funtionining of this system.

V. CONCLUSION

Generic crawler and search engines are of no use when dealing with deep web crawler. This system automatically builds attribute that can be used for categorizing form from other forms. The automatic attribute building increases uses of system when a new search topic is given to crawling. The automatic training is key feature of this system; the accuracy of this system is dependent on the programmers who generally develop the web pages. To minimize the overall crawling time, varies heuristic rules are used that are observed by researchers.

VI. ACKNOWLEDGMENT

To prepare this paper, I would like to be very thankful to my project guide and P.G. Coordinator and Head of the Department Prof. Kore K.S. in Computer Department of Sharadchandra Pawar Collage of Engineering Affiliated to SavitribaiPhule Pune University. Because of their support only I am able to complete my work.

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