ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

Reduced Latency and Energy Saving Algorithm for Query Processing In Web Search Engine

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Abstract – **The process of extracting the required information and discovering the patterns from large data sets and transforming the data sets to the understandable patterns or structures is the concept of data mining. The required essential methods are applied for data pattern extraction. The most significant sectors such as marketing organizations, finance, health care systems, educational institutions, banking etc., use the concept of data mining for their specific purposes. Major concern of this strategy is the energy consumption by the Central Processing Unit (CPU) during the extraction process of the required information from the servers and the processing time utilized for the data retrieval is also considered[1]. In this paper, we propose the Online Scheduled-Energy Saving (OSES) algorithm which increases the efficiency of the CPU in servers by reducing the energy and time consumption for the query process in the web search engines. When the query is entered in web search engines, the query efficient predictors calculates the processing time and processing volume and this algorithm forwards the query to the respective query processing node. Thus, due to this task by the algorithm, energy consumption of the CPU in servers can be minimized[2].**

Keywords- Data set, Energy consumption, DES (Dynamic Equal Sharing), Heuristic online algorithm, Optimal online algorithm, Query Efficiency Predictors (QEP).

INTRODUCTION

THIS concept of data mining is the process of extracting the understandable or usable data from larger sets of raw data in data centers. It is also termed as Knowledge Discovery Data (KDD). The collected data is commonly stored for efficient analysis and access in the data warehouses. Data mining algorithm are used for the retrieval of data [1]. It has the advantage of extracting the exactly needed data for the users entered in the web search engines. The aspects of data mining are automatic pattern identification, assumption of the data outcomes, production of essential and needed information and aims on huge data bases and data sets. The various sectors that utilize the data mining are retail industries, telecommunication, health care systems, education systems etc. Each of them uses this concept for their data retrieval and utilization effectively. The web search engines contain immense number of web pages to extract results for user queries. These queries enter the query processing nodes of web servers which are hosted in the large data centers. In order to maintain these data centers, few requirements such as power supply, fire suppression, thermal cooling, and tele-communication facilities are implemented [3]. Thus users expect the response data in sub-seconds of time. The processing nodes of the servers consume some amount of electricity for data retrieval. The energy consumed by data centers is very huge, that is in tens of megawatts power. This, in turn emits large amount of carbon-di-oxide which is the major cause of global warming. This energy consumption by CPU's has to be minimized for its efficient working and to decrease the response latencies[2].

The energy consumption and the response time for the query processing is considered for profitability and reducing the environmental impacts. In this paper, the Online Scheduled-Energy saving algorithm is implemented for the reduction in energy consumption of the CPU in the servers which causes the major part of energy consumption. To this end, the technology which is Dynamic Voltage and Frequency Scaling (DVFS) is considered with BM-WAND algorithm. The voltage and frequency of CPU of the servers are varied for lower energy consumption but it takes longer response times. This variation of voltage and frequency is based on the query to be processed. DVFS uses core-utilization policy which imposes that query processing nodes consumes more energy and the response latencies are also reduced. Thus, the proposed Online Scheduled-Energy Saving algorithm aims to reduce the tail latencies of the query process as the significant strategy. This scheduling algorithm selects the most suitable CPU frequency which would be efficient to process the user query on per-core basis by using the value of the QEP. It uses two strategies based on which the algorithm works [4]. First is the calculation of the number of postings required for the query and second is that to calculate the response time for the given number of postings. The algorithm uses these values to select the CPU frequency for processing the query. By this working, the energy can be comparatively reduced and also the response latencies are minimized [6].

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

It also becomes eco-friendly since if the energy consumption, heat emitted by the servers and the carbon-di-oxide gas released are very much reduced.

The rest of the paper is structured as follows: section2 provides Literature Survey about the reference papers. Section3 contains the detailed description of the proposed work. Section 4 .The paper is concluded in section5 followed by the references in section6.

II. LITERATURE SURVEY

WORKLOAD SHIFTING ALGORITHM:

The web search engines process thousands of web queries and their response time is fraction of a second for data retrieval. The key operations in web search engines involve web crawling, indexing and query processing. Because of the space and power requirements, large scale web engines are spread in various locations in different data centers. The workload has to be shifted from data center of higher energy prices to lower prices. Thus workload shifting algorithm is implemented which is online algorithm. Initially the workload of each data center is estimated. Based on the workload value, the query is forwarded for energy efficiency. The query is mapped with local data center when it exceeds the response time limit. The overall idea is to forward queries data centers that consumes cheaper electricity. The advantage is that the workload shifting algorithm initially takes into account of all the data center workloads and compares with query workload and forwards the query to the most appropriate data center with low energy consumption. Thus, Servers are efficiency utilized. This algorithm every time checks for the data centers workload and compares with the query workload for each query whenever the query is entered in web search engine which does not satisfy the time efficiency.

a. DAAT (DOCUMENT-AT-A-TIME) APPROACH AND WAND OPERTOR:

The text search engines are widely used in web environments and enterprises. The quantity of the data to be searched in increasing at constant rates with sub-second response time and expected search accuracy irrespective of the query's complexity and size of data set. Thus the two-level approach is implemented to evaluate the query and decrease the run time latency. At the first level, approximate evaluation is used to identify the candidate's information and considers only the queries number of occurrences. At the second level, the implemented system checks if the user queries are fully evaluated and their exact scores are computed. After this, by using dynamic pruning techniques, the efficiency of the evaluation process is improved with effectiveness. The WAND (Weak AND), which is new Boolean construct. This evaluation is used to improve the performance. For the two level for query evaluation method to decrease the run time latency, WAND operation us used. It supports pruning and increases efficiency of web search process, which is widely used in object oriented framework. In the implemented system, sometimes there is some loss of precision because of the pruning of the queries [4].

b. DYNAMIC EQUAL SHARING (ONLINE) ALGORITHM:

The high response quality is the most challenging strategy for the service providers which are more significant than energy consumption. In the proposed system, for high response quality scheduling on multi core systems with core level, DVFS support is considered. This problem has two steps of solution. First, they used "Cumulative Round Robin "policy for job distribution on to the cores and "water filling" technique for power distribution dynamically among the cores. Second, is that the jobs are scheduled on a single cores system by using optimal online algorithm (online QE). Combining these two, a DES (Dynamic Equal Sharing) is implemented for scheduling. It takes the advantages of DVFS architecture and thus achieves high service quality with low power consumption. The proposed system takes advantage over core – level DVFS architecture to have advancements in quality improvement and energy saving. Thus DES which is an online algorithm achieves good quality with minimal rate of energy consumption. Dynamic equal sharing algorithm is examined in the continuous and discrete speed scaling process. It is unable to use the ideal speed to finish the work as continuous case [5].

c. RECONFIGURATION STRATEGY:

The allocation of right amount of resources required for given computation process is a critical problem. And also, the computing systems are configured to utilize only certain amount of resources in order to manage high load peaks even though it causes energy wastage if the resources are not completely utilized. To reduce consumption by lowering frequencies of idle CPU'S, the problem in the stream parallel computations is considered. Initially, reconfiguration strategy is applied which shows the possibility to add or remove the computation

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

resources at runtime and also to display the possibility to dynamically change their frequency during its runtime. A model to choose the best solution in the area of energy consumption. And also the frame work called Deep pack inspection, for the validation process for the application with highly varying rates. This implementation does not affect the performance strategy. This approach reduces the energy consumption based on number of workless & on their frequencies. The proposed Deep packet inspection application maintains an high utilization factor of the system by reconfiguration process that uses only needed resources. This approach is not applicable to different applications. The concept of hyper threading interaction with this approach is not explained [7].

d. RANK-ENERGY QUERY FORWARDING MODEL (RESQ) MODEL:

The mandatory strategies requirements for search system performance are high quality and cost efficiency. In the proposed system, selectively forwarding queries between geographically distributed search sites is considered. This concept is that query is forwarded after the query reaches the local site. Then the query is forwarded to non-local sites and finally is returns aggregation. The hybrid rank –energy query forwarding model (RESQ) model is implemented. It considers both the ranking quality and spatially decisions of the query. It results in the expected scalability with lower energy consumption and expected quality. RESQ forwarding supports both local and non-local sites partitioning strategy which returns high quality results and reducing operational cost values. The implemented Rank-energy query selective forwarding model (RESQ) achieves ranking quality, lower energy costs and required scalability. It also used by Google data centers. RESQ model may not be applicable for the distributed search systems[8].

III. PROPOSED WORK

The proposed energy saving algorithm does the task which schedules the entered query to the respective query processing node such that energy and time consumption can be reduced shown in fig 1.

In this paper, Query Predictors (QP) is also used for two predictor techniques. First, to calculate the number of postings needed to retrieve the required information for the entered query and the second one to calculate the query's latency by using the previously estimated number of posting to score [5].

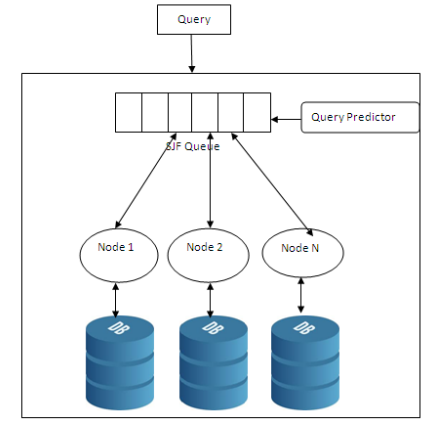
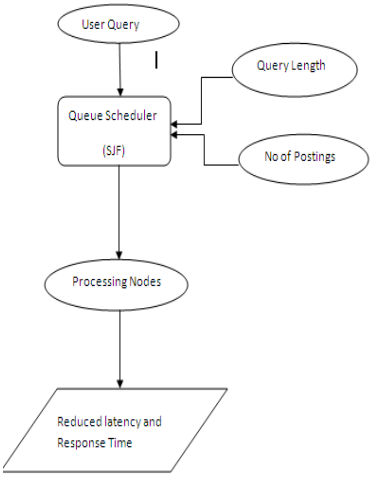


Fig 1. Job Scheduling and processing in nodes

The energy consumption is reduced and also the reduction in latency is satisfied. Sometimes, the predictor's values may vary and can be inaccurate. To compensate the prediction errors, root mean square error of the predictor is taken into account. Thus the CPU power management of query processing nodes is reduced. The incoming queries are stored in query servers which are maintained in queue format. They are processed by shortest job first policy when the CPU is in idle state shown in fig 2. Then the query is processed by the nodes. If a query exceeds the time limit, node carries out two choices.

First, it terminates the query which results in incomplete result. Second is that the query is processed completely with the required results irrespective of the other requests. The proposed algorithm is executed when query enters the query server.



ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 3, March 2018

Fig 2. Query prediction and reduced response time

Thus, based on the value of query efficiency predictors, the algorithm schedules the queries to respective query processing nodes which reduce energy consumption and response latencies [8].

IV. CONCLUSION

Data mining is the process of discovering data patterns from large data sets in the servers. Thus the CPU in the servers consume significant amount of energy. In this paper, the proposed Online Scheduled-Energy Saving algorithm along with the Query Efficiency Predictors (QEP) does the task of reduction in energy consumption and response latencies of query to be processed [10]. Query efficiency predictors estimate the processing time and processing volumes of the query if the number of postings is specified. QEP's values may be inaccurate, so the root mean square error of the predictions is considered. This algorithm selects the lowest possible CPU core frequency of processing nodes such that the query can be easily processed with sub-second response time. By this value, the proposed algorithm selects the suitable node for processing query in such a way the energy consumption is reduced and also the tail latency is minimized.

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