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Real Time Multi Feature Usage Analysis for Bandwidth Allocation in Educational Sector

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ABSTRACT

The basic approach of this paper is to study the usage analysis of student behavior in the Education sector and thereby allocating the bandwidth-on-demand basis. An efficient Web Usage Analysis Based Bandwidth Allocation using a multi-feature log data scheme is studied and simulated for result discussion. The method first reads the web usage log and verifies the presence of all the features and values. The method performs Student Usage Clustering, which considers time spent on educational web services, other websites, actions performed, amount of data downloaded, and so on. Based on these features, the method estimates Web Usage Weight (WUW) towards different clusters, and based on (WUW), the students have been classified on a specific cluster. The bandwidth allocation is performed by analyzing the clusters. For each cluster, the method estimates the Critical Bandwidth Usage (CBU) value. Based on the value of bandwidth usage, the Future Bandwidth Support (FBS) is measured by considering the availability and traffic conditions. Estimated bandwidth support is used to allocate the bandwidth for the students in the future. The proposed method optimizes network bandwidth such that it is allocated dynamically to students who need it the most.

Keywords: *Bandwidth Allocation, Dynamic, Cluster, Network, Web Usage Mining, Education Data*

1. INTRODUCTION

The modern education society provides several facilities to the students in their campus or university. The student has been allowed to access various educational services through their website provided. The entire educational organization has been covered by a specific network that has specific capacity and bandwidth constraints. However, allocating efficiency and enough bandwidth for the users of the organization is a challenging task. Not all the students access the web resources much frequently, some of the students access the resources at the time of working hours, but some of them would access them frequently. Because of the service utilization is important, based on the level of access; the educational resources depend on the bandwidth access in the web services. Bandwidth allocation is the method of allocating bandwidth to different services in a network. The bandwidth allocation is performed according to the role of services. In an educational institution, the more bandwidth is being allocated to administrative service compared to the students' services. However, it will vary according to the user profile. For the learners, bandwidth requirement would be higher at the time of examination to explore their ideas. Similarly, several approaches have been tested earlier towards bandwidth allocation. This encourages us to handle the issue with the support of student to access the educational web services efficiently.

The service analyzing intent has a great impact in web usage mining in data analysis i.e. usage through mining user information according to the usage of the web performed by the user. From the log being maintained, we can obtain different information like how many times the user visits the website, how much time they spend, how much data they download, the actions they performed, and so on. By mining such information from the usage log, we can infer much information to support different processes. The research focuses on allocating the bandwidth for different users according to their usage of the web.

By considering all these, an efficient Web Usage Analysis for Bandwidth Allocation Using Multi-Feature Log Data analysis approach is introduced in this paper. The method clusters the logs using the Multi-Feature Web Usage Clustering (MFWUC) algorithm. It measures Web Usage Weight towards various clusters of students. The allocation is performed according to the Future Bandwidth Support (FBS) measured for the students.

RELATED WORK

The problem of bandwidth allocation in different educational society has been handled with several techniques. This section explores few of the methods used recently and analyzes their performance in various factors.

In [1], the paper reveals the problem of what is to be done to increase bandwidth application efficiency. In particular, the study sought to find out how universities in Zimbabwe are managing their bandwidth. They worked with 5 college models and listed their experiences. The results show that most universities do not utilize the support channel management policy as acceptable application policy. The successful distribution of this university-managed network bandwidth depends on how the use of a number of tools is involved that take care of the costs of various technologies.

In [2], the author recommends a resource allocation system based on Dynamic User Preference (DUP). The paper first creates a model that enables dimensional measurements to cause user variability. As the network explores various factors, the dynamic user perceives the calculation for the DUP agreement by selecting multiple properties and generates Fuzzy logic (FL). The preferring factor is used in Throughput-maximizing resource allocation (TMRA) intended in that system. Based on the lower limit of the implemented DUP agreement,-TMRA is obtained

In [3], the author describes the Cross-Examining and Managing Programs for College Staff Features and Students for Institutional Difficulties in Providing Service Learning Support. He provides a quality approach study system using detailed interviews and reflex logs.

In the teaching evaluation [5], the teacher explores teacher experiences on students and opportunities and challenges in the use of virtual social networking in the field of education.

In [6], the author demonstrates the role of transforming bandwidth in Information and Communication Technology (ICT) in teacher science, technology, and engineering in various levels in online courses. They discuss various ICD-based models of education in a transitional approach to ICD integration at AES. In addition, they were set up to provide educational services for African communities (e.g., rural areas) to improve network possibilities in different ways, where continents are discussed, as discussed on various ICT sites.

In [8], this paper reveals a reasonable bandwidth allocation of access links on a P2P file sharing network and develops an application zoom model for the entire integrated network. It seeks to achieve some kind of honesty between demanding colleagues. They have a distributed bandwidth solution plan to solve the approximate problem. They then inquire into the integration of these mathematical analysis programs and the project can evaluate its effectiveness through validation number examples to achieve the global optimization of an intelligent.

In [9], this paper introduces an application-aware bandwidth structure which assigns VMs appropriate bandwidth for traffic information one step ahead, and research design and implementation. This algorithm proposes the allocation of bandwidth to virtual machines and maps them to potential hosts. Efficient lazy conversion mechanisms have been proposed such as controlled performance to balance allocation and reduce overhead.

In [10], this paper develops new bandwidth service utilization model based on CPU, memory, storage, and bandwidth resource allocation mechanisms. To implement the practical steps, the application type is seen as a player in cooperative games, and various value descriptions are used for optimization and utilization of resources.

In [13], this paper introduced a mechanism for allocating bandwidth based on the user's web usage pattern. The main purpose is to set up more bandwidth for research users on educational websites than other users. The proposed technique is obtained by following several steps. First, preprocessing is done on the blog. A functional internal calculation of the next class indicator is done in the database. ANN training for the LDA / GSVD algorithm continues to be implemented. The report will showcase and the bandwidth will be assigned at the end of this incident. The proposed method will be used on the actual blog from the university proxy server.

In [14], this paper proposed an adaptive bandwidth monitoring system that can be used in transparent educational institutions. The main purpose of the system is to improve the frequency of users visiting higher education websites. By managing this proposed bandwidth, the campus network will be restored using the Internet for the user's educational purposes. Experience Web Application Mining (WAM) in University Proxy Servers Programs with Weblog Number of Education and Non-Educational Websites which the user visited.

In [15], a review of the current issues with various applications and features already synchronizes some scheduling algorithms and IMM channel allocation algorithms. New priority-based planning schemes and dynamic channel allocation mechanisms are proposed. The proposed mechanism is expected to guarantee the minimum requirements for IMM applications that can reduce the probability calls to IMM applications by WCNS to provide only the acceptance delay QoS.

In [16], this introduces a priority-based bandwidth allocation for bandwidth service allocation using hybrid data mining techniques that have been developed to more effectively manage limited bandwidth within a university network. This method consists of two main steps namely clustering use and classification techniques. Its main purpose is to detect, analyze and predict student behavior patterns in university networks and use the Internet to identify key factors that influence one's tendencies. The proposed method is applied to the actual data of the network processed basedon the usage on service accessing.

In [18], this paper proposes a service oriented bandwidth usage depending on future requirement. It demonstrates the proposed model capability compared to the network geometry programs. This intents service requirement based allocation scheme which considers the energy efficiency for utilizing bandwidth foe service needs.

3. RESEARCH METHODOLOGY

The educational sector provides several educational services that can be accessed by the students, staff, and administrative communities. To work on these services, they share the common bandwidth. In most cases, the complaints about the unavailability of bandwidth also suffer from poor data rates. In case of students, they learn through webinars. The webinars access web pages and videos which claim higher bandwidth conditions. Moreover, they would download or upload several videos which are academic or unacademic. This leads to the need for monitoring the network traffic and thereby allocating bandwidth-on-demand basis.

3.1 WEB USAGE ANALYSIS FOR BANDWIDTH ALLOCATION

The bandwidth allocation in educational institutions has been considered and to improve the performance a real time multi feature usage analysis based bandwidth allocation

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scheme is presented. The method keep track of what the student is exploring, the page being visited, the topic of the page, the webinar being watched, the time spent on each page, the actions performed. First the web log are grouped using Multi Feature Student Usage Clustering, by considering the time spent (i.e.) time spent on educational websites, time spent on other websites, actions performed, amount of data downloaded and so on. According to these features, a Web Usage Weight (WUW) is measured towards various clusters for all the students. Similarly, the method reads the clusters, and for each cluster of students, the method estimates Critical Bandwidth Usage (CBU) value. Based on the value of bandwidth usage, the Future Bandwidth Support (FBS) is measured according to the availability, and traffic conditions. Estimated bandwidth support has been used to allocate the bandwidth for the student.

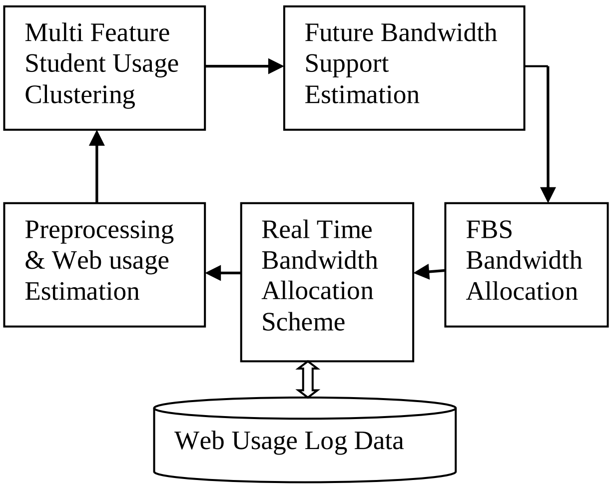

Figure 1: Architecture of proposed multi feature usage analysis based bandwidth allocation

The general block diagram of multi feature usage analysis based bandwidth allocation scheme is presented in Fig. 1. Each functional component is discussed in detail in this section.

3.1.1 MULTI FEATURE WEB USAGE CLUSTERING

The proposed scheme initially performs the grouping of web usage logs. Consider the web usage log w, contains k number of instances where each log l consists of N number of features like student name, URL visited, Meta data of the page, domain name, time spent, actions performed and so on. The presence of all the features is verified for each log to eliminate the noisy logs from the set. Further, according to the taxonomy of academic, the method counts the number of web pages or webinars and visits the topic of page to measure the web usage weight for different category of academic areas. According to the WUW measure, the cluster of the log has been selected to index. Such generated logs and clusters are used to perform bandwidth allocation further.

Consider the model maintains C numbers of clusters, according to the category of academic subjects, then the taxonomy being maintained.

<Academic Taxonomy>
<Data Mining>
<Terms>Clustering, Categorization, Supervised Learning, knowledge retrieval</Terms>
<Domains>www.mining.edu,....</Domains>
<Image Processing>
<Terms> Texture Extraction, Object Mapping, Feature Extraction, Color, Shape, Edge, CBIR, Face Recognition, Pattern Recognition </Terms>
<Domains>www.multimedia .com </Domains>
<Networking>
<Terms> Distributed Computing, Parallel Processing, Cloud, Grid…</Terms>
</Academic Taxonomy>

The above text shows the taxonomy of academy which has been used to measure web usage weight for any category and students. From the taxonomy, the relevancy of the page towards any category is measured to compute the WUW measure.

Now, first for any log l, the url being visited is identified as follows:

$$Url = \overset{size(W)}{\underset{i=1}{W(i).URL}} \qquad -- (1)$$

Now, if the URL is within the education domain of institution, then the count on the feature Edc is increased.

$$Edc = \overset{size(Taxonomy)}{\underset{i=1}{if(Taxonomy(i) \in URL)?\,1,0}} \qquad -- (2)$$

The above equation verifies the presence of URL in any of the list in the taxonomy to decide that it is an educational web site or URL. Now if it is not matched in any of the taxonomy, then the features of the web page is extracted as follows:

$$\text{Text features } Tef = \sum_{i=1}^{size(Text(URL))} Terms \in Text(URL)) \qquad -- (3)$$

Now, the simple Term frequency is measured to conclude the type of web page as follows:

$$Edc = if\ \frac{\sum_{i=1}^{size(TeF)} Tef(i) \in Taxonomy}{size(Tef)} > Th?\,1,0 \qquad -- (4)$$

The above equation (3) decides the type of web page according to the text features present in the web page. This will be performed for each student logs split from the web log. The students personalized log is generated as follows:

$$\text{Personalized log } Pl = \sum_{i=1}^{size(W)} W(i).Student == S \qquad -- (5)$$

The equation (5) shows how the personalized logs of student S is identified and split to generate clusters. According to the logs, the method estimates the various measures as follows:

The total time spent Tts is measured as follows:

$$Tts = \sum_{i=1}^{size(Pl)} Pl(i).TimeSpent \qquad -- (6)$$

Further, the time spent on educational web sites are measured as follows:

$$TsE = \sum_{i=1}^{size(Pl)} Pl(i).TimeSpent\ \&\&\ Pl(i).Type = Educational \qquad --(7)$$

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Similarly, the time spent on non educational sites is measured as follows:

$$TsNE = \sum_{i=1}^{size(Pl)} Pl(i).TimeSpent \;\&\&\; Pl(i).Type = NonEducational \quad \text{-- (8)}$$

On the other side, the number of actions performed is measured as follows:

$$Tap = \sum_{i=1}^{size(Pl)} Pl(i).Actions \quad \text{-- (9)}$$

Similarly, the amount of data downloaded is measured as follows:

$$Tdd = \sum_{i=1}^{size(Pl)} Pl(i).Bytes \quad \text{-- (10)}$$

Now according to the value of all the above mentioned features, the value of Web Usage Weight is measured. The clustering of students according to web usage is performed based on their web usage weight. Now, to measure the similarity, the distance measure with each user's web usage weight in each cluster is measured. According to the value of cumulative distance measure on web usage weight, the selection of cluster is performed.

$$WUW = \frac{((\sum_{i=1}^{size(Pl)} Pl(i).Type{=}{=}Edu)\times 0.8)+(\sum_{i=1}^{size(Pl)} Pl(i).Type{=}{=}NEdu)\times 0.2)}{size(Pl)} \times \frac{TsE}{Tts} \times \frac{TsNe}{Tts} \times \frac{Tap}{Size(pl)} \times \frac{Tdd}{Size(pl)} \quad \text{-- (11)}$$

The equation (11) denotes how the WUW value for a single student is measured. Similarly, there will be number of WUW is measured for different students. Further, the student logs and weights are grouped under different classes like low, medium, and high according to the requirement of bandwidth to be allocated. After this analysis the clustering is performed as follows:

3.1.2 FUTURE BANDWIDTH SUPPORT ALLOCATION

The future bandwidth support (FBS) based bandwidth allocation scheme works based on the result of clustering produced. First the method identifies the cluster under which the user is indexed. The bandwidth allocation is performed by measuring the Critical Bandwidth Usage at each cluster of students. It is measured based on the values measured for clustering where it is performed in a time window manner. The entire session is split into number of small sessions. For each session, the method splits the logs of students and estimates the total time spent, time spent on educational sites, spent on non educational sites, total data downloaded, total actions performed. According to the value of these, the method computes the Critical Bandwidth Usage value for each session. Finally, a single value of critical bandwidth usage is measured. According to the value of CBU, the method computes the FBS value which is used to allocate the bandwidth for the user or student.

$$CBU = \frac{TsE\times 0.8}{Tts} \times \frac{TsNe\times 02}{Tts} \times \frac{Tap}{Size(pl)} \times \frac{Tdd}{Size(pl)} \quad \text{-- (13)}$$

$$\text{Cumulative CBU} = {\sum CBU}/{\text{Number of sessions}} \quad \text{-- (14)}$$

$$FBS = \frac{Traffic}{BandwidthAvaialbility} \times CBU \quad \text{-- (15)}$$

The method computes the CBU value for different users at different sessions to measure the cumulative value of CBU. According to the value of CBU, the method computes the FBS measure with the support of traffic present in the network as well as the bandwidth availability.

4. RESULTS AND DISCUSSION

The proposed real time multi feature web usage clustering algorithm based bandwidth allocation scheme has been well designed and implemented using advanced java. The method has been evaluated for its performance under different conditions, by varying the number of users and by varying traffic conditions. At each evaluation conditions, the proposed method has improved the performance of bandwidth allocation and utilization. The performance is compared with the existing methods DUP-TMRA (Dynamic User Priority-Throughput Maximizing Resource Allocation), Application-Aware Bandwidth allocation, Priority based allocation.

The details of features considered for the performance evaluation of proposed scheme is presented in Table 1. According to the values presented, the methods have been evaluated for its performance in the following method.

Bandwidth Allocation Performance %			
Method	100 User	300 Users	500 Users
DUP-TMRA	82	74	68
AppBag	86	78	76
Priority-Based	89	82	79
FBS	99	97	95

Table 1: Analysis on Bandwidth Allocation performance vs. No of Users

The evaluation is carried out by considering 100, 300 and 500 users in the environment. The proposed FBS allocation scheme has produced higher performance in all the cases considered.

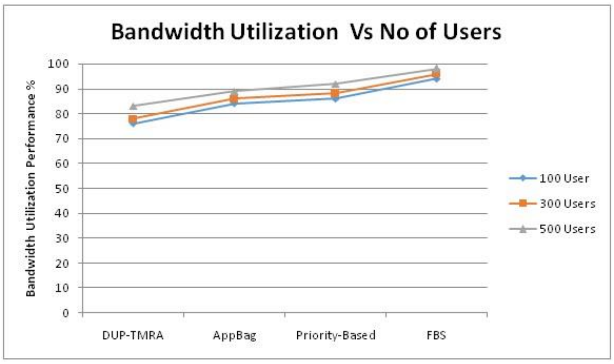

Figure 2: Analysis on bandwidth allocation performance vs. No of Users.

The performance on clustering accuracy has been measured for different methods vs number of users have been measured and presented in Table 2.

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Clustering Performance %			
Method	100 User	300 Users	500 Users
DUP-TMRA	72	76	82
AppBag	78	83	87
Priority-Based	84	89	92
FBS	94	96	98

Table 2: Analysis on Clustering Accuracy vs. No of Users

. The evaluation is carried out by considering 100, 300 and 500 users in the environment. The proposed FBS allocation scheme has produced higher performance in all the cases considered.

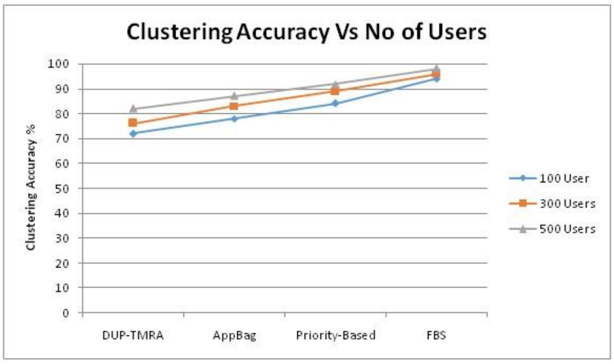

Figure 3: Analysis on Clustering Accuracy vs No of Users.

The analysis on clustering accuracy performance vs number of users is evaluated and the proposed FBS approach has produced higher clustering accuracy than other methods in each test case considered.

5. CONCLUSION

This paper has analyzed and performed bandwidth allocation for campus networks in educational society. The method groups the users according to their habits and behaviors of accessing the web resources. The clustering has been performed according to the Web Usage Weight (WUW) which is measured based on different factors and features. Such grouped students are measured for their Critical Usage Support (CUB) based on which the FBS measure is computed. According to the value of FBS, the method performs bandwidth allocation. The performance of the method is measured on various parameters and their results are compared with the results of other methods. The proposed FBS allocation scheme has produced higher performance in allocation as well as in bandwidth utilization by producing high quality cluster of users.

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