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Towards School Assessment Resources Sharing Using Cloud Computing Platform

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Abstract

Cloud computing becomes an important technology in developing a collaborative application model for the management and sharing of resources. This research focused on sharing of examination resources among schools. Cloud computing platform is used to implement the proposed collaborative model for examination resources sharing among schools. By using the model of software as a service (SaaS) a practical application has been designed to facilitate the management of school to manage the examination resources. The examination resources sharing mechanism is modeled by applying Multi-Person Prisoner's dilemma technique. This technique provides an incentive mechanism that would justify and encourage users to contribute resources into the application.

Keywords: Cloud computing, collaborative model, assessment resources, resource sharing, multi-person prisoner's dilemma

1 Introduction

With a number of complexities in sharing of assessment resources among schools, this research focus on addressing these challenges by proposing a new collaborative model for ensuring proper management of assessment resources such as examinations, test, and exercise documents among schools. Innovation

can be just an idea or knowledge such school assessment resources sharing technique that can be used for people to improve their quality of life [8]. School assessment can be defined as an on-going process of gathering and interpreting information about students learning. The output of this process is used in making decision about what to teach and how well students have learned [6],[7],[10]. In an outcome-based education, assessment plays a pivotal role. The teaching or learning process targets an outcome-based education that invests in problem solving, evaluation, creativity and deeper learning [13].

There have been several problems and issues pertaining to management of school assessment. This is due to the traditional approaches used by the schools, issues of inefficient delivery system and lack of collaborative management. There are also the needs to devise a means in which schools can share and benefit assessment resources. The above mentioned problems make it necessary to find a technological approach that can handle all possible setbacks to management and sharing of school assessment activities.

Cloud computing is receiving considerable attention to individual users and organizations. According to National Institute of Standard and Technology (NIST) [1], cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (network, servers, storage, applications and services). It can be rapidly provisioned and released with minimal management effort to service provider interaction. The features of cloud computing can be listed as *on-demand self-service*, *broad network access*, *resource pooling*, *rapid elasticity*, and *measured service*. The three service models of cloud are *infrastructure as a service* (IaaS), *platform as a service* (PaaS) and *software as a service* (SaaS). The service models can be deployed into four (4) methods: *public*, *private, hybrid* and *community cloud*.

2 Related Works

Several significant studies on assessment management and educational resource sharing are conducted over past few years. [12] Focused on designing a teaching resource sharing system based on cloud computing architecture to improve the efficiency of resource use, promote the sharing of information resources and educational applications based on cloud platform. The platform is capable of solving the duplication of digital resources, realizing the sharing of software and hardware teaching resources and promoting collaboration among regional teaching groups.

[5] Proposed a new collaborative learning system based on cloud computing. The study came up with a new model of collaborative e-learning called a collaborative cloud in which knowledge modeling and market economic mechanism are utilized to optimize the collaborative e-learning resources. The model has maximized the involvement of students in the learning and assessment activities. [2] Proposed cloud computing in the implementation of android-based mobile assessment system to support different kind of learning and assessment content. A versatile

and comprehensive mobile assessment system was designed with special emphasis on the usage of open standards.
[3] Proposed the use of tablets PC in school assessment. The objective of this study is to organize classroom assessment activities and provide real time analysis report to improve the effectiveness of classroom assessment. According to this study, with the evolution of information technology, tablet Pc's and cloud computing are increasingly used in all areas of learning and assessment activities. However most of the systems developed such as Android-Based Mobile Assessment System and TeachScape's Classroom Walkthrough program have some shortcomings, which focused more on the assignment and exam than the general classroom evaluation activities.

3 The Proposed Model

The proposed cloud based school assessment resource sharing model consists of three units that are connected to each other. These units are *client's access unit*, *cloud management unit* and *resource pool unit*. The customer (clients) group consists of a number of system users; those can access the system using PC's, mobile phones and tablets devices via internet connection. Registered users provide their user-id and password to access the system. New users must go through registration process before access granted is given. The cloud management unit coordinates and manage resource(s) access, user login and user registration. And lastly the resource pool unit consist of the system database and resource pool. The cloud model consists of five (5) main elements and can be denoted as a set C.

C = {*Data Centers, Cloud Services, Service providers, Users, Internet*}.

Each of the elements of set *C* plays a specific role in the setting up and implementation of cloud environment. This research uses the concept of SaaS and using private cloud to deploy the assessment resource sharing system. Several cloud users (schools) may want share certain resources which they have a common interest. For instance, several schools want collaborate and share assessment resources. The reason to this approach is to upgrade and expand the standard of their internal examinations and other evaluation activities such as test and exercise. Several schools have many resources in common. However, there is need to share resources that are not common to both. Normally in the open sharing systems, some users may not be willing to share their resources for the overall good of system users. The efforts to bring together resources from different users requires for introducing some kind of negotiation model. The multi-person prisoner's dilemma technique can be used to model the assessment resource sharing using. In this proposed model, a game theoretic approach using multi-person prisoner's dilemma is adapted with an incentive mechanism that will encourage collaborators to contribute more resources to the system.

3.1 Prisoner's Dilemma

A Multi-Person Prisoner's Dilemma is a game where two players are partners in a crime with each player having two options of either confessing or not confessing. The players are to choose an action simultaneously. And each player wants to maximize his utility. Note that higher numbers are much better (more utility). If neither suspect confesses, both will get a utility (payoff) greater than if both of them confess. However, if one player confesses and the other does not, the one who confesses get higher utility (payoff), while the other will get lower utility [9] [11].

3.2 Incentive mechanism

Document sharing can be encouraged by using incentive mechanisms. Without such incentive mechanisms, some users of the collaborative system may opt to hold their resources or they may not be willing to contribute, and this could lead to decreased system and resource utilization. In this research, a peer-approved technique is used. The peer-approved scheme uses a reputation system to maintain users rating. Users build their ratings depending on the metrics adopted such as number of files shared by user or number of downloads made by a user. Users are allowed to access files from others with lower or equal ratings. New users are allowed to access small number of files before they gradually build their ratings. Thus, users increase their ratings by sharing more files [9]. The peer-approved scheme is very flexible where users need not to make decisions any time when accessing file and it is more practical to implement since no pricing is involved. Moreover, in peer-approved users access files based on the number of files they shared. Since the goal of each user is to gain access to wider variety of files, this could motivate users to share more files in order to increase their ratings.

3.3 Applying Prisoner's Dilemma to Document Sharing and the use of Peer-Approved Incentive Mechanism

The resource sharing problem is modelled as prisoner's dilemma. In this resource sharing problem, several users contrary to prisoner's dilemma that involves two players are considered. Therefore, the following assumptions are made:

- There are N users (schools) in the system, and each user has at least one resource to share.
- User can either share one resource (preferred alternative) or can decide to share many resources (non-preferred alternative).
- User rating is proportional to the number of resources that have been shared.
- We have three categories of users. Main contributors, partial contributors and weak contributors.

Let: main contributor (m_c) be a user that shared at least P resources, partial contributor (p_c) be a user that shared at most Q resources, weak contributor (w_c) user that shared only R resource or no resource where P, Q, and R are variables that can be adjusted by system administrator and (P > Q >R).

Suppose m_{c1} shared d_1 resources, m_{c2} shared d_2 resources,…m_{ci} shared d_i resources. Where $d_1, d_2, \ldots d_i \in Z^+$ (positive integer). Thus, $D= d_1 + d_2 + \ldots + d_i$ which is the total resources shared by main contributors.

This implies

$$D = \sum_{k=1}^{i} d_k. \quad (1)$$

Suppose p_{c1} shared e_1 resources, p_{c2} shared e_2 resources,…p_{cj} shared e_j resources. Where $e_1, e_2, \ldots, e_j \in Z^+$(positive integer). Thus, $E= e_1 + e_2 + \ldots + e_j$ which is the total resources shared by partial contributors.

This implies

$$E= \sum_{m=1}^{j} e_m \quad (2)$$

Suppose w_{c1} shared f_1 resources, w_{c2} shared f_2 resources,…w_{ck} shared f_k resources. Where $f_1, f_2, \ldots f_k.(0 \leq f \leq 1)$. Thus, $F= f_1 + f_2 + \ldots + f_k$ which is the total resources shared by weak contributors

This implies

$$F = \sum_{n=1}^{k} f_n \quad (3)$$

The overall resources shared in the system are given by:

$$G = D + E + F$$

This implies

$$G = \sum_{k=1}^{i} d_k. + \sum_{m=1}^{j} e_m + \sum_{n=1}^{k} f_n \quad (4)$$

In this situation, all system users can access all the system resources. But with an incentive mechanism, the system users are categorized into three (3) groups:

- Main contributors (m_c).
- Partial contributors (p_c).
- Weak contributors (w_c).

The categorization of users is based on their contributions. The boundary of main contributors is set to at least P resources in order to encourage users to contribute more to the system to attain the category of main contributors. The variable P is set by the administrator and it can be adjusted to accommodate system needs. Despite all this restrictions, the system is open and accessible to all users. However, users can access resources available to their category. There are several applications that give benefits to users based on system usage and contribution.
Main contributors are those that shared at least P resources to the system. This group of users can access all the system resources. The utility of main contributors is given by:

$$\text{Utility } (m_c) = \sum_{k=1}^{i} d_k + \sum_{m=1}^{j} e_m + \sum_{n=1}^{k} f_n \quad (5)$$

Partial contributors are users who shared at most Q resources (Q < P). This category of users contributed resources less than the main contributors. Thus, with peer-approved incentive mechanism where users can access resources based on their ratings, this category of users can access all the resources except the last S resources (where S is a variable that can be adjusted and S<Q); they are denied access to last S resources in order to deny them the advantage of main contributors. Thus,

$$\text{Utility } (p_c) = \left(\sum_{k=1}^{i} d_k + \sum_{m=1}^{j} e_m + \sum_{n=1}^{k} f_n\right) - S \quad (6)$$

The weak contributors are those who shared R resource(s) or no resource at all. This category of users can access only resources shared by other weak contributors. Thus,

$$\text{Utility } (w_c) = \sum_{n=1}^{k} f_n \quad (7)$$

The incentive mechanism aims on competition between users, so that each user will contribute more resources in order to get access to more system resources. This mechanism could ensure maximal system and resource utilization.

4 Conclusion

This paper highlighted on educational resources sharing systems, online examinations and assessment system in the school. Cloud computing technology is used in order to achieve the objectives of the study using its various services and deployment models. The paper also proposed the model for the assessment resources sharing system based on multi-person prisoner's dilemma. The future work of this research is to focus on the development of the proposed model on real cloud environment using OpenStack cloud architecture.

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