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An Efficient Software Prediction on Cloud infrastructure With Self- Adaptive Classification Model

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Abstract -- Business information is stored in the cloud environment and offers proficient software services to the clients using internet. Cloud infrastructure delivers traditional software services among different cloud users. Decentralized Self-Adaptation Mechanism has been implemented to maintain decentralization applicable to QoS exhibited cloud system. However, designing decentralized Self-Adaptation Mechanism is not trivial as it failed to port the model in CloudSim platform. Service delivery models of cloud computing understands the risks of data but fails to establish the dynamic software prediction framework on cloud infrastructure. In this paper, we design a dynamic software prediction framework on CloudSim platform called as the Software Prediction with Self-adaptive Classification (SPSC) model. SPSC model predict the software required by the user and establishes communication dynamically for providing software services to cloud users. SPSC model is split into two phases. The initial phase starts with the software prediction followed by the second phase that performs the process of classification. SPSC model performs the software prediction using autoregressive method in cloud zone for improving the software service availability rate depending on the client needs. We then present a classification model performed based on the information obtained using Principle Component Analysis (PCA). PCA based classification improves the quality of services and also used to easily identify the software peculiar features in cloud zone. The identification of peculiar features helps to improve the classification rate averagely by 12 percentages. SPSC model experiment the work in CloudSim platform with Amazon web service dataset on the factors such as execution time, classification accuracy rate and Quality of Service rate on client request.

Keywords: Self-adaptive Classification, Cloud infrastructure, Software prediction, Principle Component Analysis, Quality of Service, Autoregressive method

I. INTRODUCTION

Cloud computing is an emerging technique that assigns the task of software scheduling services. Different types of software connection services are carried out in the cloud infrastructure. The connection of servers that are integrated together in the network infrastructure is termed as cloud. The cloud data center is operated by the users to store the business information. The storage capacity of service provider varies based on the pay policy. Cloud storage also includes the data storage process. If the data is stored in the cloud, access is provided to the authenticated users for using the information.

The primary uses of cloud computing is software storage. Cloud provides the service where the software storage resource and the software requirements of user are examined. With the cloud software storage space getting accumulated on various third party servers using the online process, the existing system is not effective in providing software storage service at a lower cost and more reliability and security are not provided. The advantage of cloud software storage deepens on the user satisfaction within the minimal process time. There are different clouds software systems in which certain amount of works were carried out on using the software for storing web email messages as described in [7]. Other software in cloud is also available for storing all methods of numerical data. Some cloud software storage systems are small processes, but others are so large which fill up an entire warehouse.

Cloud offers the vast storage of data throughout the world. The idea of cloud computing includes the web infrastructure, virtualization technologies and other promising technologies. With the recent developments in cloud, users use different types of devices ranging from laptops, smart phones, PC to PDA. The devices are used for software storage and application services offer the cloud computing providers. Certain advantages of the cloud computing technology include the cost savings, high accessibility and scalability. The indexing and metadata management model as described in [6] helped to access the scattered information with reduced latency. The metadata management improved the software file system access for large scale applications.

In Cloud infrastructure, there are varied types of cloud services. They are Infrastructure as a service (Iaas), Software as a service (Saas), and Platform as a service (Paas). In Iaas, the clients ensures that application memory space, connectivity in terms of network, the operating system in which they operate are provided but does not organize the cloud infrastructure. Infrastructure-as-a-service (Iaas) sometime called as the Haas-Hardware as presented in [14] detected the zombie attacks but was extremely complex for distributed cloud server. The zombie explorative attack on software was not effective on detecting the accuracy in the cloud environment.

In Saas, clients acquire the ability to access and use a service hosted in the cloud. The resource allocation performed in cloud as elaborated in [11] consisted of the software service management according to the requirements of the customer whereas the management of risks related to computation was maintained by the Service Level Agreement (SLA). But however the market-maker failed to provide the regulatory and legal matters beyond the technical issues. SLA between the service providers and the users as demonstrated elaborately in [15] include the delivery ability of a service provider. The performance target of the user did not attained software cloud services but rely completely on software cloud contributor.

Business model in [5] distribute value to customers, entices customers to pay for value and uses the management's suggestion. The hypothesis satisfies what the customers want about the software from the cloud infrastructure but the consumption of cost consumption factor was higher in ratio. Cloud-Assisted Privacy Preserving Mobile Health Monitoring as demonstrated in [9] looked after the software privacy of complex parties and their data. The key private proxy re-encryption was modified to transfer the computational complexity of the concerned parties to the cloud. But the cloud was devoid of compromise clients' software privacy and service providers' with intellectual property.

IT resources as explained in [13] identified the advantages related to the migration of Software Cloud Architecture. In general, Return on Investment (ROI) model was developed into consideration under intangible impacts of Cloud Computing but the exact testing of the software was not carried out. The planning of software activities with iterative strategy and intellectual property included resourcing, planning, executing, evaluation and reassessing the traceability needs with the value based set. Software configuration through Lean and Agile Management as presented in [12] failed to satisfy different process improvement standards.

Decentralized Self-Adaptation Mechanism as described in [1] vigorously recomposes and self-adapts the system with changeable QoS requirements. Market-based approach for self-adaptation was easily applicable to QoS exhibited cloud system but decentralized mechanism failed to port the market model in CloudSim.

In this work, Software Prediction with Self-adaptive Classification model is developed to predict the cloud users' need of software services. Initially, Software prediction is performed using the autoregressive method on the cloud zone. Auto regression accurately predicts the software automatically and utilizes the correct number of resources for software prediction. In the second phase, Self-adaptive Classification is carried out using the principle component analysis. PCA improves the quality of services and enhances the software classification process. The software in the cloud is efficiently classified by comparing the specified software space using PCA algorithm.

The structure of this paper is as follows. In Section 1, the basic problems in providing the software services on the cloud infrastructure are described. In Section 2, a Software prediction with Self-adaptive Classification (SPSC) model is presented for classifying the software services depending on cloud users need. Section 3 and 4 outline experiment results with parametric factors and present the result graph. Finally, Section 5 demonstrates the related work and Section 6 concludes the work.

II. SOFTWARE PREDICTION WITH SELF-ADAPTIVE CLASSIFICATION MODEL

We begin this section by considering an architecture diagram which serves as the basis for the software prediction with self-adaptive classification model. We introduce two phases to improve the software service availability rate and improve the classification quality of services. The main objective of the SPSC model is to predict the software and establish the dynamic communication for gaining effective business based resource management on cloud infrastructure. The software service in the cloud infrastructure helps to build the precise business processing model. In SPSC model software service is deployed as the software component. Each request is submitted by the cloud users for the software prediction and classification services.

SPSC predicts the software's based on examining the history and evaluating the cloud user need using the auto regression technique. The software prediction in SPSC model improves Quality of Service (QoS) rate on client request. The predicted software is classified in the SPSC model using the Principle Component Analysis (PCA) in the second phase. PCA based classification enhances the accuracy rate and interested in classifying the best software services for business applications. The overall architecture diagram of the SPSC model is illustrated in figure 1.

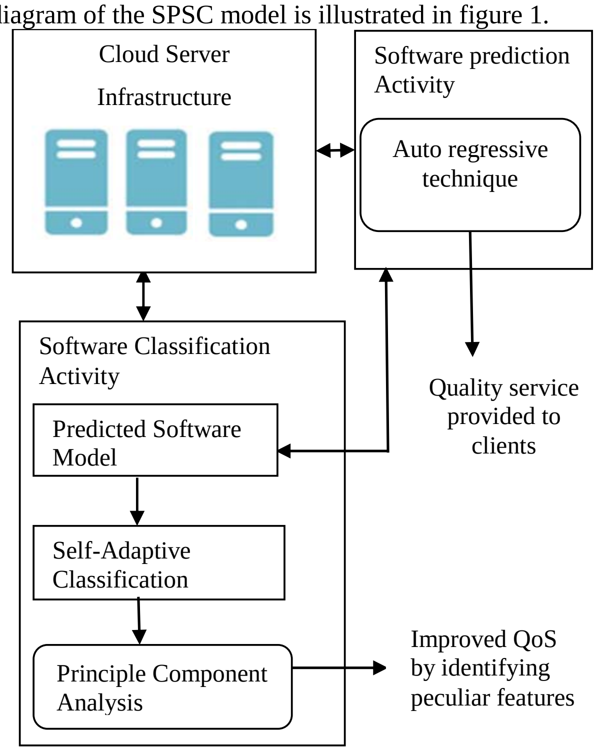

Fig. 1 Overall Architecture Diagram of SPSC Model

As illustrated in Figure 1, SPSC model is carried out with different features of cloud servers. The cloud server infrastructure refers to the network computing in SPSC model. The network based cloud server performs the software prediction and classification process. In the first phase, the SPSC model performs the software prediction activity. The software prediction activity is carried out using the auto regression technique. Auto regression technique uses the history information to easily predict the software need of the cloud users. The auto regression process produces the output variable result which is linearly useful for the classification activity.

During the second phase in SPSC model, the software classification activity is carried out using the PCA. PCA extract the set of software features to classify the set of predicted software's from the cloud server. The set of observation is clearly carried out in the SPSC model to remove the peculiar software features from the cloud zone and also for effective software processing on business environment. Principal components improve the classification accuracy rate with the sensitive software variable information. The design considerations of SPSC model comprises of two phases namely, (i) Auto-regressive software prediction (ii) Self-adaptive classification model. The elaborate explanation of the two phases is provided in detail in the forthcoming subsections.

A. *Auto-Regressive Software Prediction*

The auto regression based software prediction for the SPSC model in cloud environment involves predicting the software's for the cloud users. In SPSC model, software prediction efficiency is improved based on the resources of the cloud user. Initially, a call is made to the Application Programming Interface (API) to initiate the process of acquisition. The updating process is performed in cloud zone by the machine boot up with the predicted software. With the help of the historical data, the software outcome in the SPSC model is predicted with higher accuracy rate.

To apply the auto regressive method, initially the system behavior is analyzed over the software prediction on cloud infrastructure. The optimization of the system behavior in SPSC model reduces the execution time taken to predict the software. The advantage of the SPSC model is that it can be applied to different performances management cloud system with dynamic framework. The software prediction of SPSC model is estimated using the incoming cloud user request in SaaS cloud infrastructure, so that the execution time is reduced for the future time periods. The main objective of auto regression technique is to filter the cloud software based on the user request in SPSC model. The SPSC auto regressive filter is measured as,

$$\lambda(f) = \beta * \lambda(t-1) + (1-\beta) \qquad (1)$$

Where $\lambda(f)$ denotes the auto regressive filter and 'β' denotes the constant. 't' is the time interval taken to predict the software on cloud infrastructure. The auto regression for SPSC model is carried out in three steps. The three steps involved are illustrated in Figure 2.

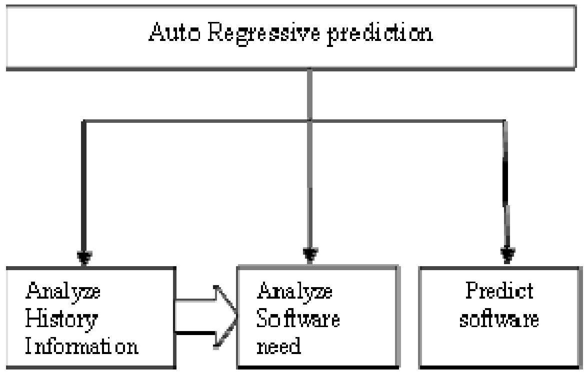

Fig. 2 Auto regression Steps

The steps involved in auto regression are described as follows. The first step analyzes the history information. Based on the history information, the second step analyzes the software need for the cloud users. Finally, the third step checks (i.e.,) predict the software from the cloud infrastructure. SPSC model efficiently predicts the software value using auto regression technique during a latency series which is linear with the combination of past software values and current software values. By obtaining the past software value and comparing with the current software value, the software requirements of the cloud user is efficiently identified.

The right number of software in SPSC model is the one which provide the desired prediction result with the minimal execution time. In the cloud, certain users' browse the information while the others post the service request for software classification. In SPSC model, the Software Prediction User Behavior model is developed and depicted in Figure 3.

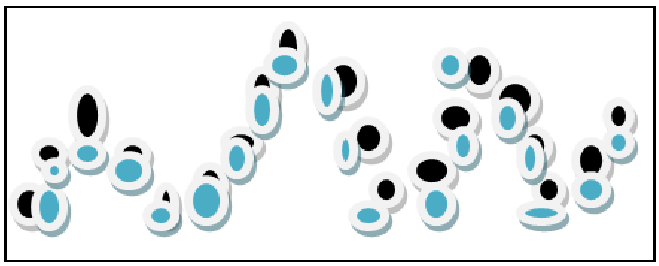

Fig. 3 Software prediction User Behavior model

Actual Software in Cloud
Predicted Software based on User behavior

The Software Prediction User Behavior model is constructed from the overall performance of the customers and computes the probability of a user visited each page based on the history information. Using the history information, the number of visits to a single page is calculated from the total number of users in the cloud system. With the result obtained from the computation, software need is analyzed. The number of visits to each web page in cloud helps in predicting the user's software need.

B. Self Adaptive Classification Model

The Self adaptive classification model based on the PCA in SPSC model classifies the relevant software information from Amazon web service dataset. PCA also provides assistance to reduce the CPU utilization time by reducing the dimensions involved in the classification process. The classifier system in SPSC model follows four operations as illustrated in figure 4. The operations are software acquisition, software prediction, software classification and software assessment.

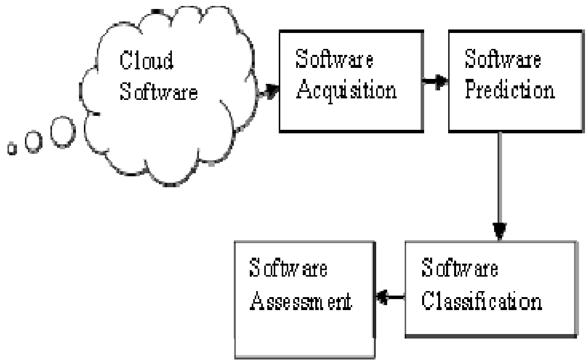

Fig. 4 Self Adaptive Classification process

In cloud infrastructure, the software is acquired from different web pages. Followed by this, the acquired software is then predicted using the auto regression technique. Next, the predicted software extracts the features to classify the system using Principal Component Analysis. For this, in SPSC model, an Eigen vector with a group of software characteristics is classified in PCA. Finally, the classified software cloud system is judged with the help of the software assessment part.

In PCA, the sample software in cloud zone is converted into a row vector. A row vector in SPSC model is constructed by concatenating each row with first row in sequence. The row vector in PCA is build by merging collectively the row vectors of 'n' cloud software. Let us assume that R_i is a row vector for a sample software i, where i = 1,…,n, then a mean cloud software vector ϑ of 'n' row vectors is calculated to extract the required principal software features.

$$\vartheta = (\frac{1}{n}) \sum R_i \quad (2)$$

The extracted software features in (2) efficiently classified using the self adaptive software classification. The past software value is subtracted from the current software value to assess the system classification accuracy.

$$Software\ Assessment\ (\in) = R_i - \vartheta \quad (3)$$

As in (3), the software assessment is obtained by the difference between the row cloud vector R_i and the software vector ϑ. The classified software model is then used to effectively assess the SPSC model.

C. Algorithmic Step of SPSC model

Software Prediction with Self-adaptive Classification model is developed to perform acquisition, prediction and classify the cloud user's need. The algorithmic step of the SPSC model is described as,

Begin
Input: Cloud Server infrastructure 'S1','S2', 'S3' …'Sn'
Output: Dynamic Software Classification on CloudSim platform.
Step 1: Construct the Cloud Server to provide software acquisition service
// Software Prediction Activity
Step 2: Performs the auto regression technique
Step 3: Filter the software with $\lambda\,(f) = \beta * \lambda\,(t-1) + (1-\beta)$ formulization
Step 4: Software prediction based on
Step 4.1: Analyze History Information
Step 4.2: Analyze Software need
Step 4.3: Predict software
// Software Classification Activity
Step 5: Row vector matrix R_i, Cloud software vector ϑ extract the principle features
Step 6: Perform Principle Component Analysis based classification with predicted cloud service software
Step 7: Asses the classified software to compute the accuracy rate of classification End

The above algorithm explains the activity of software prediction and software classification with the help of step by step procedure. Software prediction is carried out using auto regression method. The software classification is carried out with the help of PCA where the PCA performs the software acquisition, prediction, classification and assessment. Finally, PCA improves the quality of services and enhances the software classification process.

III. EXPERIMENTAL EVALUATION OF SPSC MODEL

Software prediction with Self-adaptive Classification (SPSC) model uses CloudSim platform to perform the experimental work. The goal of CloudSim is to provide a global and extensible simulation framework that facilitates model, simulation, and experimentation. The emerging cloud computing infrastructures and application services allow the users to focus on the design issues with a precise system. The issues are investigated with small information which is connected to the cloud based infrastructures and services.

A data center comprises of many software's with CPU core equivalent to 1000, 2000 and 3000 Microprocessor without Interlocked Pipeline Stages (MIPS). 8GB RAM is used for the experimental work and 1 TB of storage. JAVA CloudSim platform uses the Amazon web service dataset to experiment on the factors such as execution time taken to predict the software, classification accuracy rate, QoS rate on client request, percentage of software application successfully adapted on cloud, mean classification time and CPU utilization rate.

Classification accuracy rate is defined as the number of software's that are correctly classified to satisfy the user request. Classification accuracy is measured in terms of accuracy percentage (%). QoS rate easily identify the software peculiar features in cloud zone, so that the quality of service on client request is enhanced in SPSC model. Software application on cloud helps the users to access the SaaS, and improve the adaptive rate. The adapted rate is measured in terms of percentage. Execution time for software prediction in SPSC model is defined as the amount of time taken to perform the prediction operation. The execution time is measured in terms of seconds (sec).

$$Execution\ Time = Start\ time\ of\ Software\ Prediction - End\ time\ of\ Software\ Prediction$$

Mean Classification time is defined as the amount of time taken to perform the software classification after the effective prediction of the software. Mean classification time is measured in terms of milliseconds (ms).

$$CPU\ utilization = Cloud\ user\ services * [User\ Software\ Request\ (bps)]$$

CPU utilization refers to the processing of cloud user services and user request for software services. The CPU utilization time is measured in terms of Mega bits per second (Mbps). The user request on each bit per second is measured to compute the CPU utilization.

A. Result Analysis of SPSC Model

SPSC model are analyzed against the Decentralized Self-Adaptation (DS) Mechanism and Service Delivery (SD) models. Each technique has its own respective accuracy level and execution time. The existing and proposed result is analyzed through table values and graph points. Table 1 tabulates the execution time with respect to the number of service provider. We make a comparison of our model, SPSC model and the state of art.

No .of service provider	Execution Time (sec)		
	DS Mechanism	SD Model	SPSC Model
5	316	287	243
10	355	323	293
15	546	474	405
20	523	456	416
25	742	626	553
30	849	743	628
35	966	859	753

TABLE 1: TABULATION OF EXECUTION TIME

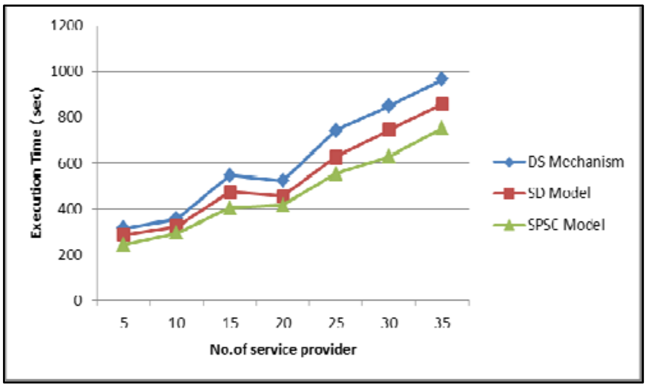

Fig. 5 Performance of Execution Time

The above figure (figure 5) illustrates the execution time based on the service provider. The right number of software in SPSC model is the one which provide the desired prediction result with the minimal execution time. Auto regression technique filter the cloud software based on the user service provider, so the execution time is reduced up to 17 -26 % when compared with the DS Mechanism [1]. Software prediction is estimated with the incoming services in SaaS cloud infrastructure, so that the execution time is reduced up to 8 – 18 % on the future time periods of SPSC model when compared with the SD Model [2].

The classification accuracy rate of our SPSC model is presented in table 2. It is easy to find that the classification accuracy rate is improved using SPSC model than the state-of-art methods.

Clients Count	Classification Accuracy rate (Accuracy %)		
	DS Mechanism	SD Model	SPSC Model
50	65	72	83
100	66	76	85
150	67	78	86
200	69	79	87
250	70	80	89
300	71	81	90
350	72	82	91

TABLE 2: TABULATION OF CLASSIFICATION ACCURACY RATE

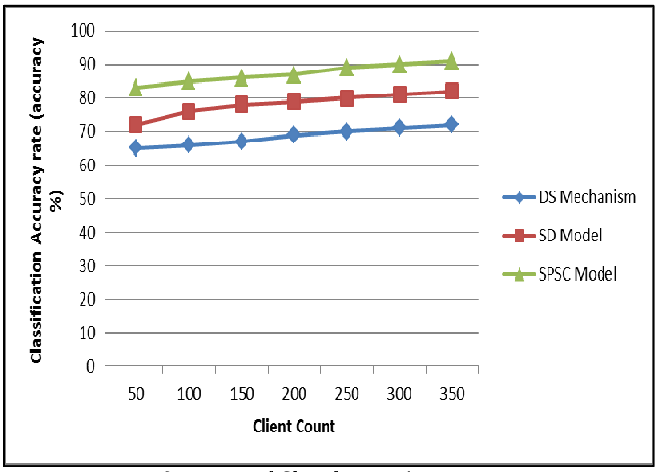

Fig. 6 Measure of Classification Accuracy rate

Figure 6 describes the classification accuracy rate based on the client count. The extracted features classify the self adaptive software's, and improve accuracy rate by 26 – 28 % when compared to the DS Mechanism [1]. As the client count is increased, the accuracy percentage is also improved gradually. The past software value is subtracted from the current software value to assess the system, and as a result the classification accuracy is improved by 10 – 15 % in SPSC model when compared to the SD Model [2].

QoS Count	QoS rate on Client Request (%)		
	DS Mechanism	SD Model	SPSC Model
3	78	86	90
6	79	87	91
9	80	89	92
12	81	89	93
15	82	90	93
18	83	91	94
21	85	91	95

TABLE 3: TABULATION OF QOS RATE ON CLIENT REQUEST

Table 3 describes the QoS rate on client request based on the quality of cloud service count. As the count improves, client request QoS rate is also improved.

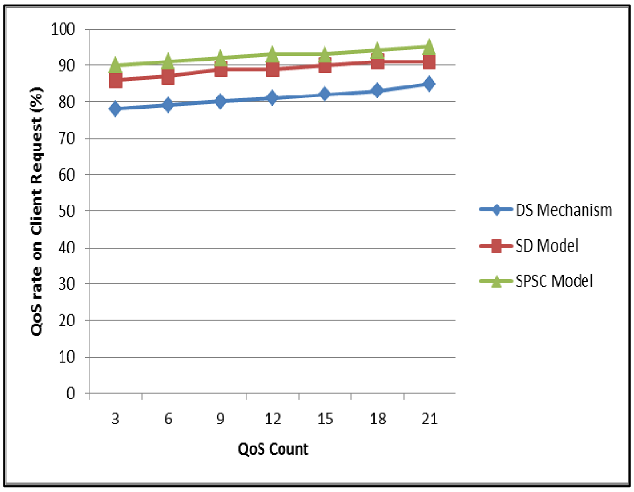

Fig. 7 Measure of QoS rate on Client Request

Figure 7 describes the QoS rate of the client request for the DS model, SD model and SPSC model. SPSC model predicts software value during a latency series and a linear combination of past software values and current software values, improves the QoS rate by 11- 15% when compared with the DS Mechanism [1]. QoS rate improved with the initial processing of software acquisition. The users browse the information and perform software classification with 3-5 % higher QoS rate in SPSC model when compared to the SD Model [2].

User Request Software	Software Application Adapted Rate (%)		
	DS Mechanism	SD Model	SPSC Model
10	6	7	8
20	12	13	15
30	18	21	23
40	22	26	28
50	25	27	31
60	29	33	37
70	32	37	41

TABLE 4: SOFTWARE APPLICATION ADAPTED RATE TABULATION

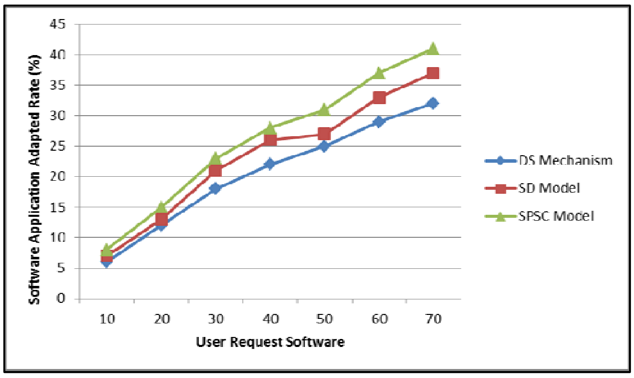

Fig. 8 Software Application Adapted Rate Measure

Table 4 and Figure 8 presented the measure of software application adapted rate based on the user request software. The user request in SPSC model uses the Software Prediction User Behavior model to build the system with 24 -33 % improved adapted rate when compared to the DS Mechanism [1]. The history information calculates the number of visits for a single page from the total number of users in the cloud system, and as a result the adapted rate is improved by 7 – 15 % when compared to the SD Model [2].

No. of Software Classified	Mean Classification Time (ms)		
	DS Mechanism	SD Model	SPSC Model
7	200	162	148
14	391	352	293
21	541	503	455
28	713	652	587
35	860	805	732
42	995	952	870
49	1260	1150	1020

TABLE 5: TABULATION OF MEAN CLASSIFICATION TIME

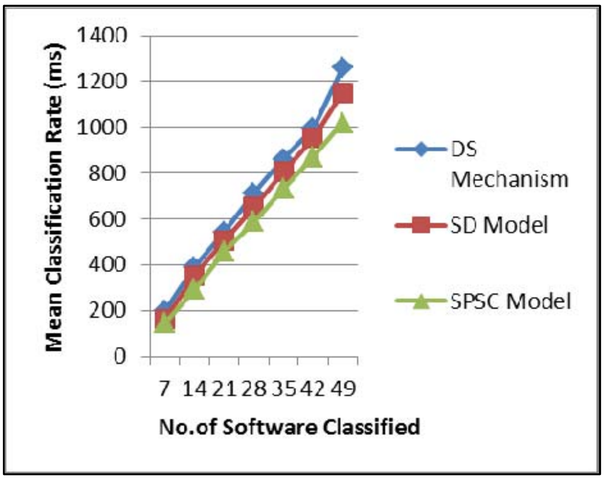

Fig. 9 Measure of Mean Classification Time

Table 5 and Figure 9 illustrate the mean classification time based on the software's in the cloud. The row vector in PCA is build by merging collectively the row vectors of 'n' cloud software, and as a result the classification time is reduced from 12 -26 % in SPSC model when compared to the DS Mechanism [1]. A mean cloud software vector ϑ of 'n' row vectors is calculated to extract required software with 8 – 16 % minimal classification time when compared to the SD Model [2].

Cloud User Services	CPU Utilization Rate (Mbps)		
	DS Mechanism	SD Model	SPSC Model
2	82	75	66
4	110	105	93
6	139	121	111
8	135	126	113
10	158	147	133
12	171	154	141
14	221	203	189

TABLE 6: TABULATION OF CPU UTILIZATION RATE

Table 6 describes the CPU utilization of the DS mechanism, SD model and SPSC model. The CPU utilization values are tabulated using the formularization based computation.

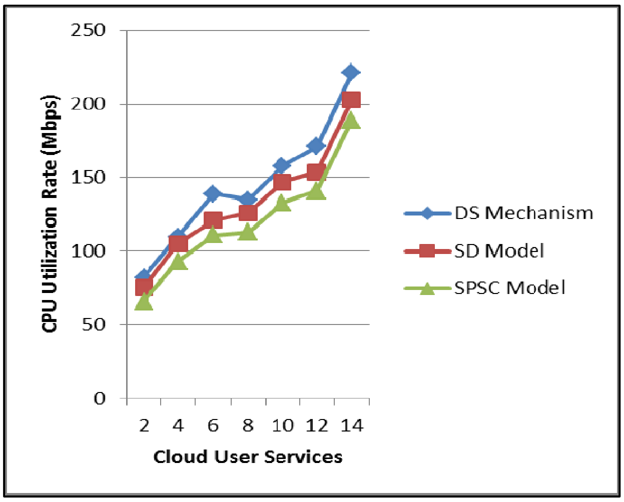

Fig. 10 Measure of CPU Utilization Rate

Table 6 and Figure 10 describe the CPU utilization rate based on the cloud services. The Self adaptive Classification based on PCA in SPSC model classifies the relevant software information and reduce the CPU utilization rate by 14 – 20 % when compared to the DS Mechanism [1]. PCA provides assistance to reduce a CPU utilization time by 7 – 13 % in SPSC model when compared to the SD Model [2] using the reduced dimension factor.

Finally, Auto regression accurately predicts the software automatically and utilizes the correct number of resources for software prediction. Self-adaptive Classification is also carried out using the principle component analysis to enhance the software classification process. PCA based classification enhances the accuracy rate and classifies the best software services for business applications.

IV. RELATED WORK

Cloud computing applications in research provide insight into certain current related educational and research areas [16] and evaluate the demanding applications of cloud computing models. Virtual Power plant (VPP) application as demonstrated in [18] represented a convenient range with Distributed Energy Resources (DER). Such range operated in various software modes, each with a set of unique software control requirements. The main drawback of using cloud communication standard is that it failed to adopt the multi-vendor environment.

Electric power capacity available in each area as shown in [19] assumed a cloud computing environment in which both processing capability and network bandwidth were allocated simultaneously. Power capacity for aggregating requests of multiple areas failed to switch servers in sleep mode. A framework to measure the quality of services and prioritization is described in [17] to create an important impact to act as a healthy competition among cloud provider. Cloud satisfies the SLA but ranking algorithm did not coped up with QoS attributes. The QoS attributes were also not adopted for the fuzzy sets.

Fuzzy Logic in context aware service discovery as illustrated in [4] routinely recognized the circumstance and accordingly identified the right set of healthcare software services among the available ones. Semantic formalisms assist the situation and services model in terms of domain ontology theory but the web service for the classified and open software registries were not requested. Service delivery models of cloud computing as illustrated in [2] understood the risks of data. Service delivery models of cloud computing is directly proportional to the value benefit it guards but failed to develop a framework with the dynamic communication establishment on cloud infrastructure.

Trusted Third Party, tasked with comfort precise security characteristics within a cloud environment in [3] provided an ideal security facilitator on distributed cloud environment. Trusted Third Party within a cloud environment facilitated trust and used the cryptography concept but failed to focus on improving accessibility and quality of software services provided in cloud environment. The security issues in cloud environments appeared to be a highest importance in [8] for allowing an enhanced and safer deployment of clouds. The cloud access throughout the industry with the software security paved the way for bigger issue for the researches. Data security in cloud computing are discussed in different ways in [10] and evaluated the desired electronic interactions and extracted the financial tools.

Time-series Pattern based Noise Generation Strategy (TPNGS) analyzed the probability fluctuation of privacy risk in [20] from the perspective of time intervals. But TPNGS failed to protect customer privacy under multiple malicious service providers. The service provider has huge threat on noise obfuscation.

V. CONCLUSION

Software prediction with Self-adaptive Classification (SPSC) model effectively predicts and classify the user needed software. The SPSC model establishes the communication dynamically for providing software services to the cloud users. SPSC model predicts the software based on the auto regressive method used in the first phase. The auto regression process, output variable result are produced which linearly is useful for the classification activity. In second phase SPSC model performed classification based on the Principle Component Analysis (PCA) information. PCA based classification improves the quality of services and also used to easily identify the software peculiar features in cloud zone. PCA is an efficient identifier in terms of 12.489 % minimal execution time and provides utmost 15 % better classification accuracy in cloud server architecture than the state-of-the-art methods. Experiment demonstrates that the relative error points on the software prediction are reduced and software application adaptive rate on user cloud request is improved.

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