Performance Evaluation of Check Pointing and Threshold Algorithm for Load Balancing in Cloud Computing

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Abstract— The cloud computing is practice of using a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or personal computer, it builds on the idea of using a remote server or infrastructure as a software service. The data that is stored in centralized virtual machine known as cloud and it can be managed by an end user using services provided. Cloud Service Provider (CSP) are designed for giving users the services based on their demands and are to be paid for being served. As there is large number of requests so the load increases, hence a Load balancing is done to reduce the energy consumption and maximize resource utilization. In this paper, the work is based on the task migration when virtual machine gets overloaded at the time of cloudlet execution. The CSPs are responsible to assign tasks to the most appropriate virtual machine for the execution. When any of the virtual machine gets overloaded, the task is migrated from one virtual machine to another or it could be queued which can be decided by the threshold and check pointing algorithm by minimizing the processing time, energy and resource consumption.

Keywords—Load Balancing, Virtual Machine Migration, Threshold Algorithm, Check Pointing Algorithm

I. INTRODUCTION

Cloud Computing is the environment which provides on-demand & convenient access of the network to the computing resources like storage, servers, applications, networks and the other services which can be released in minimum efficiency way. Users retrieved data and modified data is stored by client or an organization in centralized data called cloud. Cloud is a design, where cloud service provider provides services to user on demand and it is also known as CSP stands for "Cloud Service Provider". It means that the user or the client who is using the service has to pay for whatever he/she is using or being used and served. The main problem of cloud computing is load balancing. Load balancing helps to distribute the workload among various nodes efficiently and fairly by providing high resource utilization and better response time using various load balancing algorithms.

Features of Cloud Computing are:

There are mainly five essential characteristics of the cloud computing. It is understandable that missing any of those characteristics a service can't be considered as cloud computing.

- On demand capabilities: Cloud computing provider will secure the cloud computing services it considered as a software vendor. The user can access the services and can change the services through online control panel without interaction with the server or it can be done directly with the provider.

- Broad network access: Now a day, all digital devices like tablet, mobiles, laptops, etc can access broad networks wherever they get connected with a simple network access point. In business, this feature is very useful because employees can stay connected with contracts, proposals, projects and customers during office hours even off-times.

- Resources Pooling: In the cloud computing, the employee can share the information or services at the same time from any location at any time within business management software hosted at the cloud.

- Rapid elasticity: Cloud computing offers flexibility and scalability up to the extent that you can add or remove the users and services as per your need.

- Measured service: The cloud computing is so affordable that you can access services and for what type of service you used you must pay for it. It can be monitored from both sides including provider's side and user's sides and hence improves transparency.

Load Balancing

Load balancing is a procedure in which the total load of the network is reassigned to the individual nodes to make resource utilization successful and to enhance the response time of the job. In the meantime, remove a state in which some of the hubs are under stacked while a few others are over stacked. A load balancing algorithm depends on the present nature of the system and it does not consider the previous nature of the system which is change in nature. This load measure in the terms of CPU load, amount of memory used, delay or Network load.

Characteristics of load balancing:

- It improves the performance of the system.

- It maintains system stability.

- It builds fault tolerance system.

- Resources are utilized efficiently.

- Cost is reduced.

Cloud Computing Services

Now a day, Cloud computing is an advance technology, which provides different services like software as a service, platform as a service, infrastructure as a service.

Infrastructure as a service (IaaS) -IaaS is the capability of doing processing, storing and run software which is given to the consumer. It's also referred as the "Resource Code" which provides resources as the services to a user. This work is done by the service provider For E.g. Host Firewalls

Platform as a service (PaaS)-PaaS gives the computational resources on which services and applications can be host and develop. For E.g.: Online Photo Editing, Google Docs, YouTube [13]. As the name implies this type of cloud computing providers' development environment as a service where user can write application and develop software.

Software as a service (SaaS) -SaaS is the capability of using applications which these applications are run on cloud infrastructure. The users access these applications through internet connections. These kinds of clouds offer the implementation of some specific business threads that gives specific cloud capabilities. For e.g. Gmail, Facebook.

Cloud Deployment Models

The following are the four deployment models of cloud-
Public Cloud- Public cloud services are provided through virtualized environment developed using polled shared physical resources and share on public network such as internet. Same infrastructures shared by multiple clients. Through this model, operations can be performed efficiently and effectively. Public cloud service based on-demand pay-per as use and may be free.
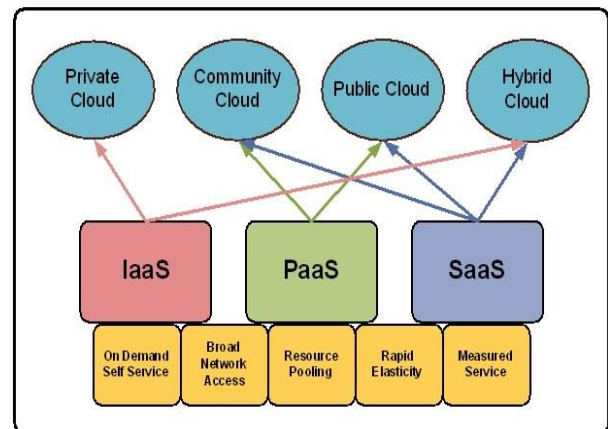

Figure 1.1: Cloud computing models

Private Cloud-This cloud is specially developed for a single organization. In private cloud dates is shared by the organization in a way so that the interference of the outsiders can be avoided. This fact makes the private cloud more secure but less flexible as compare to public cloud.eg. Amazon Virtual Private Cloud, Microsoft Private Cloud.

Hybrid Cloud-Hybrid cloud is a collection of many clouds like private cloud and public cloud. While working with private clouds sometimes we need some more storage space so we use some of public clouds this is known as cloud bursting. In this case organization will only have to pay for the extra space being consumed.

Community cloud-When different organizations have a common interest then instead of using different clouds they will share the infrastructure among each other. One or a few association can be utilized the group cloud yet they all offer basic attributes, for example, their main goal, security, polices, consistently consistence need. This undertaking can be given to an outsider or can be taken care of inside.

In this paper the load balancing is done by migrating the task when the virtual machine gets overloaded during cloudlet execution. The Cloud Service Providers are responsible to assign the task to the most appropriate virtual machine and the migration is decided by the Threshold and Check Pointing Algorithm which reduces the energy consumption and maximizes the resource utilization by which an effective load balancing is done.

The paper is organized as follows, Section I contains the introduction of load balancing in cloud computing, Section II contains the related work of cloud computing, Section III explains the methodology with flow chart, Section IV describes the results and discussion and Section V concludes the paper with future directions.

II.   RELATED WORK

Sambit Kumar Mishra et al. in 2017 [1] proposed an algorithm for the distribution of virtualized resources with minimal waiting time and optimal makespan. The proposed approach balances the load at VM-level to avoid overloading VM node. A task with a high priority gets service first to maximize the profit of Cloud Service Provider.

N.R. Rejinpaul et al. in 2012 [2] proposed a smart checkpoint infrastructure for virtualized service providers and fault tolerance model for real time cloud computing. The checkpoints are stored in a Hadoop Distributed File System. This allows resuming a task execution faster after a node crash and increasing the fault tolerance of the system, since checkpoints are distributed and replicated in all the nodes of the provider.

Mladen A.Vouk in 2008 [3] explains cloud computing a moderately late term, expands on many years of exploration in virtualization, circulated registering, utility processing, and all the more as of late systems administration, web and programming service ."Cloud computing" is the following characteristic stride in the advancement of on-demand data innovation administrations and items. To a huge degree, distributed computing will be founded on virtualized assets. This paper examines the idea of cloud PC a percentage of the issues it tries to address, related examination themes and a "cloud usage accessible today".

Sean Carlin et al. in 2011 [10] explains that cloud computing is the distributed architecture that centralizes the resources of server on a scalable platform which provides services on demand. Various cloud deployment models are discussed i.e. public, private and hybrid. The main security issues and risks are discussed; sharing of resources is one of them. Customers are not satisfied with the data security on cloud. Cloud service providers must tell the customers about the deployment models. They need to use the third-party auditor so that they can gain the trust of customers. For this, new techniques need to be developed and older should be removed for easy work in cloud architecture.

Dawn Song et al. in 2012 [16] described the data-protection-as-a-service where different services are provided for protecting data. Two techniques have discussed i.e. FDE (Full Disk Encryption) and FHE (Fully Homomorphic Encryption). There is a comparison in these techniques based on key management, sharing, and ease of development, maintenance, aggregation and performance. The key management and access control are moved by DpaaS (Data-Protection-as-a-service) approach for purpose of balance easy maintenance and rapid development by user-side verification. Performance and ease of development offered by FDE is excellent.

Deyan Chen et al. in 2012 [17] describes data security and privacy protection issues occurred in cloud computing in all the stages of data life cycle. There are seven stages of data lifecycle: Generation, use, transfer, share, storage, archival, destruction. They have discussed some current solutions like fully homomorphic technique, data integrity, client-based privacy management tool, etc. According to the survey of Gartner for cloud computing, Public and Hybrid cloud has a revenue of $59 billion and by the year 2014 it will reach USD 149B with an annual growth of 20. The increase in the

revenue of cloud with the time shows that cloud is a trustworthy industry. But still there are some issues in cloud regarding security of data which increases the threats from hackers.

Rajwinder Kaur et al. in 2012 [18] explains that cloud computing shares information and give numerous assets to clients. Clients pay just for those assets as much they utilized. Cloud computing stores the information and dispersed assets in the open environment. The measure of information stockpiling increments rapidly in open environment. In this way, load adjusting is a fundamental test in cloud environment. Burden adjusting is appropriated the dynamic workload over different hubs to guarantee that no single hub is over-burden. It helps in legitimate use of assets. It additionally enhances the execution of the framework. There are different sorts burden are conceivable in distributed computing like memory, CPU and system load. Burden adjusting is the procedure of discovering over-burden hubs and afterward exchanging the additional burden to different hubs.

J.Srinivas et al. in 2012 [20] explains that cloud computing is an adaptable innovation that can bolster a wide range of use .The minimal effort of cloud computing and its dynamic scaling it an advancement driver for little organizations, especially in the creating scene. Cloud sent endeavor recourses arranging (ERP), Supply chain administration applications(SCM), client relationship administration (CRM) application, medicinal application and versatile application can possibly achieve a large number of clients. This paper manages Characteristics, opportunities, issues and difficulties off cloud computing. From an innovation perspective, there are technical specialized issues to solve. From an administration or purchaser purpose of view, there are crucial usability, stability and reliability issue to solve.

III. METHODOLOGY

Threshold algorithm is a process scheduling algorithm and works by maintaining a threshold value. The node which will have a value less than the threshold in terms of the execution time and failure rate will be considered as the candidate node which will be responsible to execute the cloudlet.
Check Pointing is a fault tolerance algorithm. It is used to make checkpoints on the server so that if any fault occurs the task could be resumed from the earlier checkpoint maintained on the server. The task migration is done using the Check Pointing algorithm.

Following steps need to be considered for task reassignment:

1. Cloudlet Assignment: - The cloudlet assignment is the first step which is applied to search the virtual machine which is most applicable to the cloudlet execution. The virtual machine will be searched based on execution time and failure rate. The virtual machines start executing the cloudlet. The virtual machines also start maintaining the check points on the server for the efficient execution of the cloudlets.

2. Overloaded virtual detection and virtual machine migration: - The virtual machine which does not respond back will be considered as the overloaded machine. To migrate the task weight of each virtual machine is calculated. The virtual machine which has maximum weight will be selected as the machine on which cloudlet will be migrated.
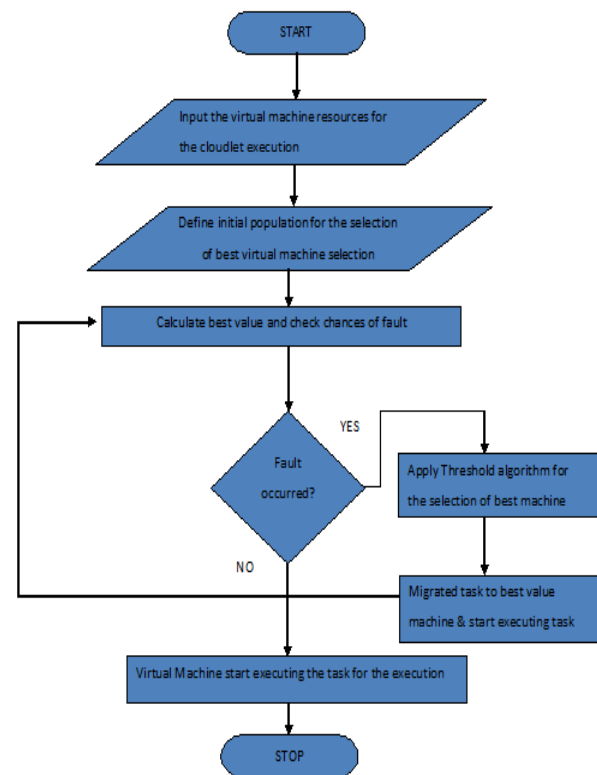Our designed model works for an efficient load balancing using the following flow of algorithms.

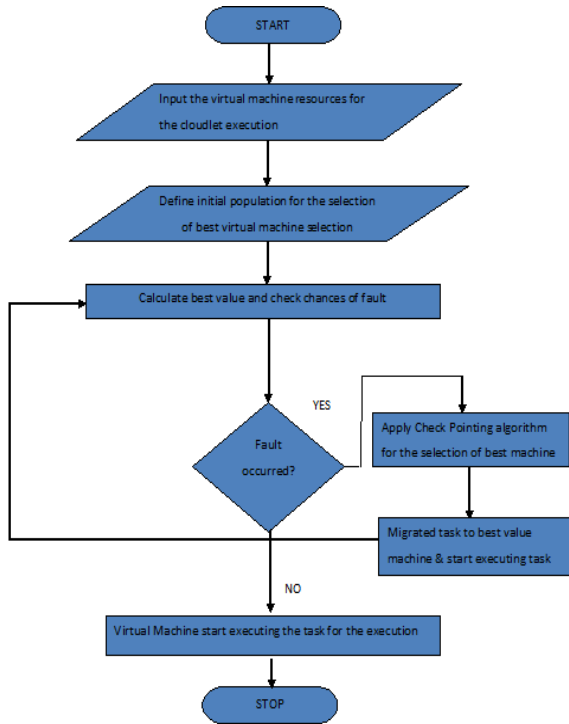Figure 3.1: Flowchart of Threshold Algorithm

equal to the time taken for the algorithm multiple by per unit energy.

Energy consumption= Time * per unit energy

- **Resource Used -** The resource used is the parameter which measure the resources used for the algorithm execution.
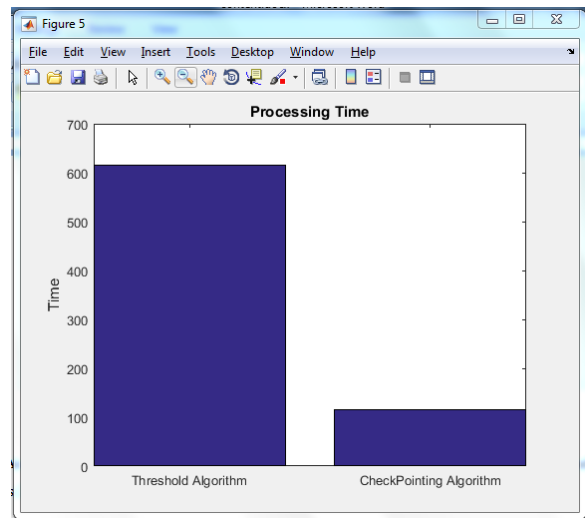
  Resource used= Time * per unit resources

Figure 4.1: Processing Time Comparison

Figure 4.1 shows the processing time comparison of Threshold algorithm and Check Pointing algorithm and it has been analyzed that Check Pointing algorithm is efficient in terms of processing time.
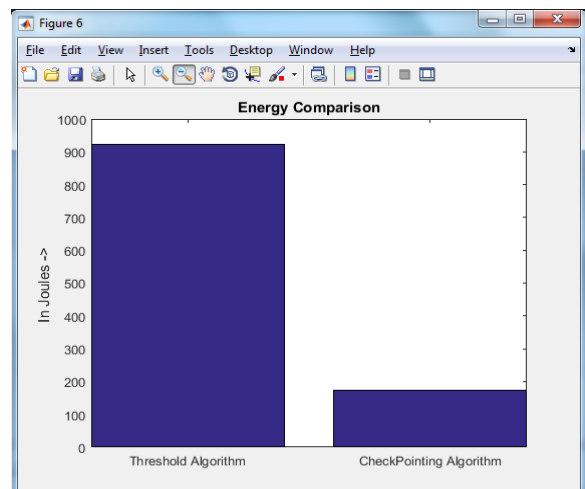

Figure 4.2: Energy Consumption Comparison

Figure 4.2 shows the energy consumption comparison of Threshold algorithm and Check Pointing algorithm and it has

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Figure 3.2: Flowchart of Check Pointing Algorithm

IV. RESULTS AND DISCUSSION

In Check Pointing algorithm the procedure for task assignment is complex, the task reassignment procedure will be implemented with less complexity and use the existing parameters for reassignment, least chances of faults and maximum level of chances for task reassignment whereas in Threshold algorithm the procedure for task assignment is not so complex, the task reassignment procedure will be implemented with least complexity and need to define the failure rate and execution time, maximum chances of failure and optimal chances for task reassignment.

The simulation is carried in MATLAB environment. We have performed the comparative analysis of Check Pointing and Threshold algorithm using the following parameters:

- **Processing Time -** The processing time is parameter which measure the time which is taken for the algorithm execution.

  Processing time = End time of the algorithm - Start time of the algorithm

- **Energy Consumption -** The energy consumption is the parameter which is used to measure the energy consumption of the network. The energy consumption is

been analyzed that energy consumption of Check Pointing is least as compared to Threshold algorithm.
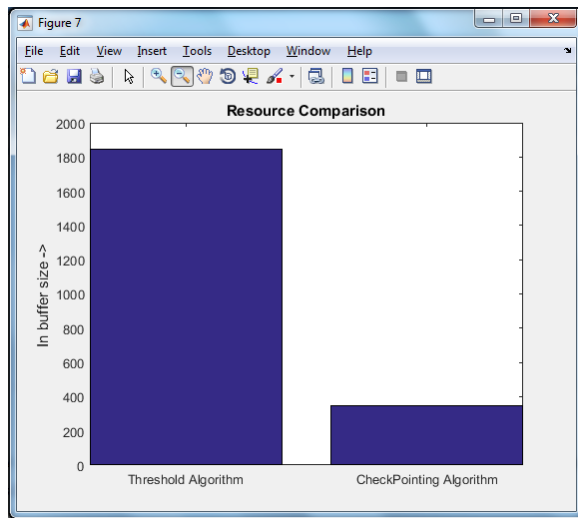

Figure 4.3: Resource Consumption Comparison

Figure 4.3 shows the resource consumption comparison of Threshold algorithm and Check Pointing algorithm. It has been analyzed that Check Pointing algorithm is efficient as compared to Threshold algorithm.

V. CONCLUSION AND FUTURE SCOPE

The cloud computing is the architecture which could be decentralized in nature. The cloudlets are assigned to virtual machines which execute assigned cloudlet and revert to the CSPs. In this research, two algorithms are compared which are Threshold algorithm and Check Pointing algorithm. The Threshold algorithm will access the cloudlet execution capability of each virtual machine and assign cloudlet to most capable virtual machine in the network, if some uncertainty happens it leads to faults in the network. The Check Pointing is the algorithm of task assignment which reassigns the task to another most capable virtual machine. The two algorithms are compared in terms of processing time, energy and resource consumption and it is concluded that Check Pointing is more efficient than Threshold algorithm when it comes to handling of more than one node.

In future, we will improve the check pointing algorithm for the virtual machine migration to reduce space utilization for improving performance of load balancing in cloud computing.

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