Enhancing Fault Tolerance of Cloud Nodes using Replication Techniques

Mridula Dhingra, Neha Gupta

Abstract: ***The cloud technologies are gaining boom in the field of information technology. But on the same side cloud computing sometimes results in failures. These failures demand more reliable frameworks with high availability of computers acting as nodes. The request made by the user is replicated and sent to various VMs. If one of the VMs fail, the other can respond to increase the reliability. A lot of research has been done and being carried out to suggest various schemes for fault tolerance thus increasing the reliability. Earlier schemes focus on only one way of dealing with faults but the scheme proposed by the the author in this paper presents an adaptive scheme that deals with the issues related to fault tolerance in various cloud infrastructure. The projected scheme uses adaptive behavior during the selection of replication and fine-grained checkpointing methods for attaining a reliable cloud infrastructure that can handle different client requirements. In addition to it the algorithm also determines the best suited fault tolerance method for every designated virtual node. Zheng, Zhou,. Lyu and I. King (2012).***

Keywords: Replication, Fine-grained checkpointing, Fault tolerance, Virtual machine.

I. INTRODUCTION

Cloud computing is a new methodology emerged in recent past for data storage and computational process. Such processes can be configured vigorously by the use of virtualization. Now a days there is a huge demands of real time systems in cloud computing. Many real time systems are not much secure but should be reliable, excessive use of real time applications in cloud environment raises the probability of faults, Dhingra and Gupta (2017). The methods that deal with fault tolerances methods are classified as reactive or proactive. Most of the fault tolerance methods are based on reactive approach. The reactive methods work on decreasing the effect of occurring faults. On the other hand proactive methods work on avoiding the occurrence of faults.. A reactive method generally includes the combination of replication and checkpointing mechanisms. Almost all of the cloud computing systems were depended on reactive methods that especially include replication, Ganga and Karthik (2013). As discussed, many real time applications are less secure, so there is a huge requirement of fault tolerance. Replication is one of the most important methods to attain the fault tolerance. In the proposed work, replication technique is performed in form of software variants running on n virtual nodes. Because of using the replication technique, expenditure for the cloud resources may accelerate. But it is necessary to evade the disastrous failure.

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II. RELATED WORK

Ganga and Karthik (2013) have suggested a technique which is based on replication and fault tolerance methods are used when the systems with scientific work-flows were used.

Das and Khilar (2013) presented a replication based scheme where service time is reduced the availability of system is increased. This method reduces the probability of imminent faults whose success rate is very less.

Alhosban, Hashmi, Malik and Medjahed (2013) have proposed a method that was based on planning and forecasting. In this technique replication and retry methods are chosen for fault tolerance.

Saranya Srimathi, Ramanathan, and Venkadesan (2015) have discussed the concept of replication and resubmission of task. A priority is given to every task based on its finish timings.

Liu and Wei (2015) have suggested a method which is based on fault tolerance in map reduce structure in which the both hardware and software failures are considered.

III. PROPOSED RELIABILITY FRAMEWORK

The proposed system consist of virtual nodes of size n, nodes input will be taken from a buffer comprises of random input sets and selected input is assigned to a virtual machine. With the help of the input, given a set of operations are performed by the virtual machines and results are recorded. The recorded results are further analyzed for reliability and decision making. The projected reliability structure will mainly alienated into three modules, these are:

1. Acceptance Computation
2. Reliability Assessment
3. Decision Mechanism

Acceptance Computation (AC) :- In this module, correctness of input selected from the buffer is evaluated, correctness of the input is verified from the accurate results and if the output is inaccurate, backward recovery is going to be implemented via replication and fresh inputs are selected from buffer again, if the results are accurate then input are considered to be corrected and further evaluated for reliability, Dhingra and Gupta (1) (2019).

Reliability Assessment (RA):- Reliability assessment is a method to evaluate the expected behavior of a system in expected and unexpected situation and should be measured in a continuous way, change of value at each computation cycle will help in decision making and default value of reliability is always 1. The proposed algorithm will measure the reliability value and that value is further given to a module for decision making.

With the help of this algorithm, if the reliability value is found less than 1 then the system is recovered in backward direction with the help of fine grained checkpointing, Dhingra and Gupta (1) (2019).

A. **Algorithm to measure the Reliability of Virtual Nodes** Dhingra and Gupta (2) (2019).

In this algorithm reliability of virtual nodes will be measured.

Step 1: Initial Reliability (IR) will be considered as 1.

Step 2: Initialize n as 1 where n is the flexibility factor .

Step 3: Initialize Reliability Factor (RF) as 0.2, Minimum Reliability (MR) as 0 and Maximum Reliability (MAR) as 1.

Step 4: Node Status (NS) will check the correctness of results.

Step 5: If NS = = correct then

Step 6: Reliability of virtual node is measured using the formula where IR will be multiplied with RF and result will be added with IR (It must lie between MR and MAR).

Step 7: If the value of n is greater than 1 then the value of n will be decreased by 1.

Step 8:End if

Step 9: Else if NS produces incorrect result then

Step 10: IR will be multiplied by RF and n and result will be subtracted from IR.

Step 11: The value of n will be added by 1.

Step 12: End else if

Step 13: If the value of IR is greater than or equal MR then

Step 14: MR will be equal to IR.

Step 15: End if

Step 16: Initialize the counter variable (count) as 1.

Step 17: While count is less than or equal to 4.

Step 18: counter will be incremented by 1.

Step 19: If IR is less than MR then

Step 20: NS is considered fail or dead.

Step 21: Remove this node and add new node

Step 22: End if

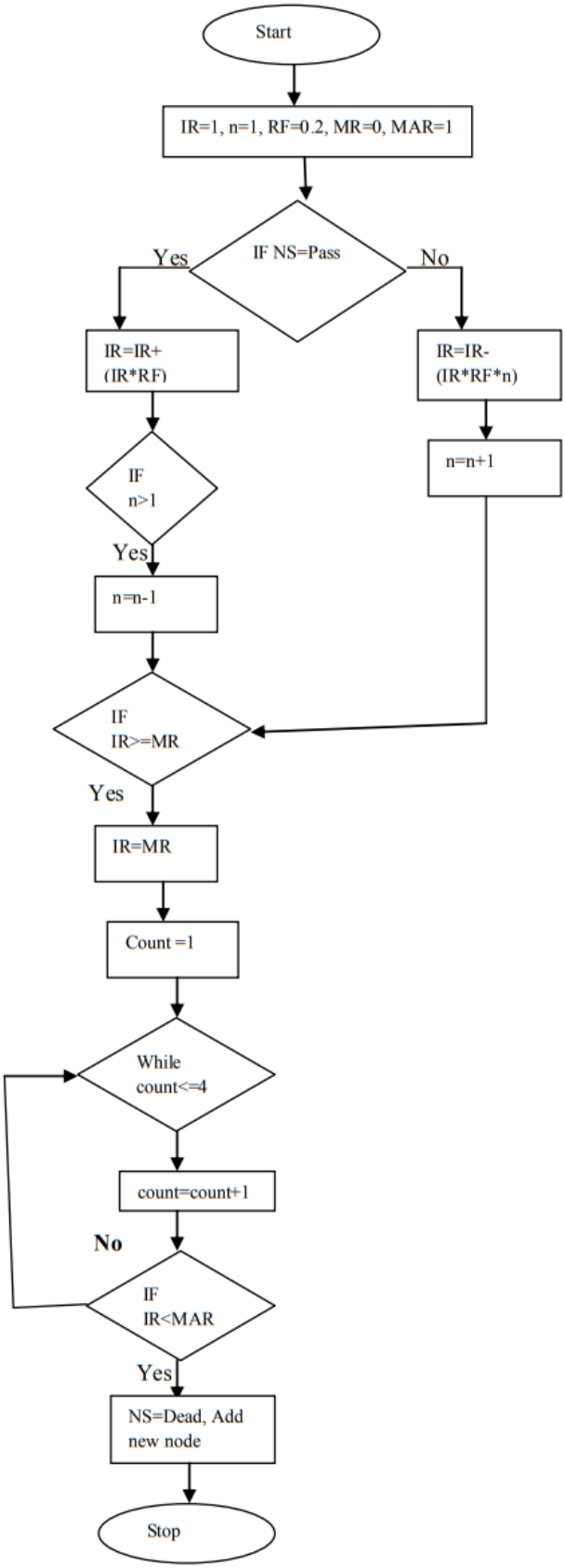

Figure 1: Reliability of Virtual Nodes

B. Fine-grained Checkpointing

Fine grained Checkpointing algorithm (proposed) will assume that the interval length of checkpointing is not freezed during the time the user's job is being executed. The algorithm evaluates the subsequent checkpointing interval at the time of the present checkpoint. This is computed on the basis of the failure history of VMs. Based on the good or bad failure history, the interval between the checkpoints is increased or decreased.. Also, this algorithm computes the next interval length of checkpointing during the time of present checkpointing., Dhingra and Gupta (2) (2019).

C. Replication

Replication requires the minimum number of VMs should be available in cloud framework to handle the user's request. It becomes a costly affair to replicate each VM. So we only replicate those VMs which are executed and have larger impact on cloud performance if they are failed. Dhingra and Gupta (3) (2019).

Algorithm using Replication Technique Dhingra and Gupta (3) (2019).

Step 1: Create Virtual Node (VN)
Step 2: Define Reliability Time (RT), Minimum VN development time (MT), VN development time (DT), Minimum creation Time (MC)
Step 3: While (VN) do
Step 4: If(RT< MT && DT<MC)
Step 5: Evaluate finest VN
Step 6: End if
Step 7: Else
Step 8: Goto Step 1
Step 9: End While

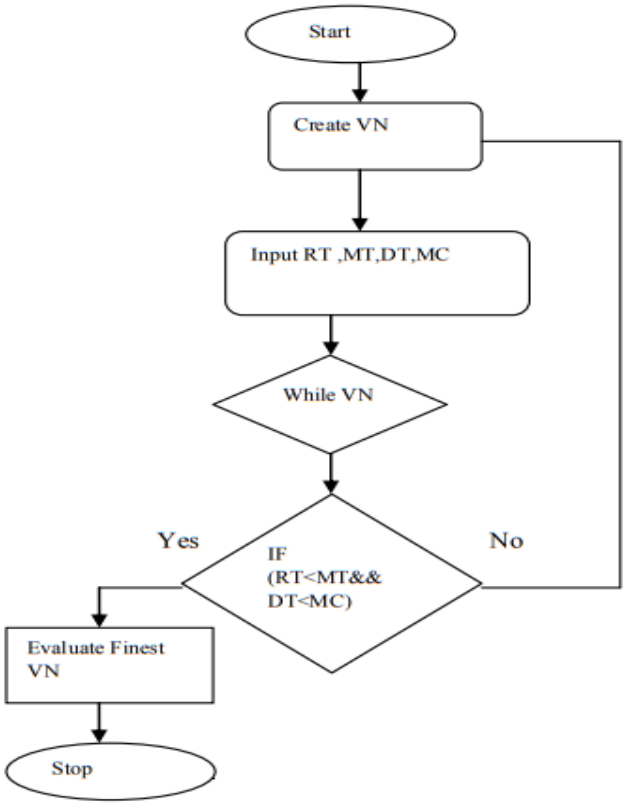

Figure 2: Replication of Nodes

Decision Mechanism (DM):- In this module the virtual machine with the highest reliability will be selected, if two nodes are having the same reliability then the node having smaller IP address will be selected as the best reliable machine, Malik and Huet (2011).

D. Algorithm of Virtual Machines for Decision Mechanism

This module will select the virtual machine having reliability more than system reliability level (SRL) value. If a number of virtual machines passed SRL level is more than 1, then this module will select the machine with highest reliability, Dhingra and Gupta (3) (2019).

IV. IMPLEMENTATION

In the proposed framework Cloudsim, a simulation tool is used for the evaluation of results. It is convenient, free of cost, user friendly simulator and it allows regressive execution of applications.

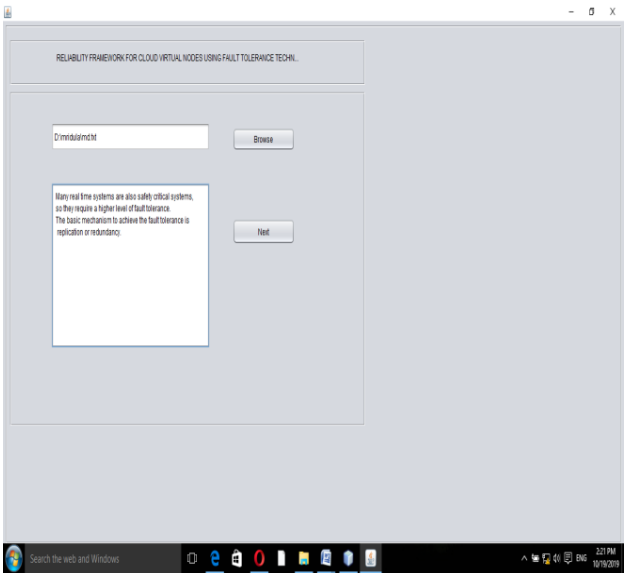

Figure 3: Input Buffer

In this reliability framework input has been taken from input buffer, after that virtual machines will be created.

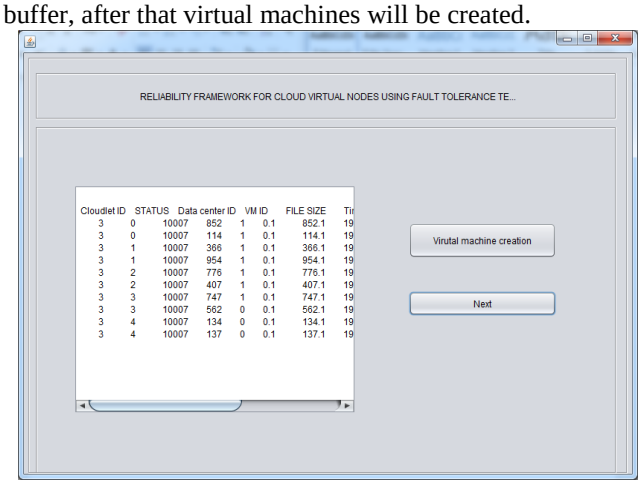

Figure 4 VM Creation

Here ten virtual machines are created, after creation of virtual machines results will be checked whether it is correct or not.

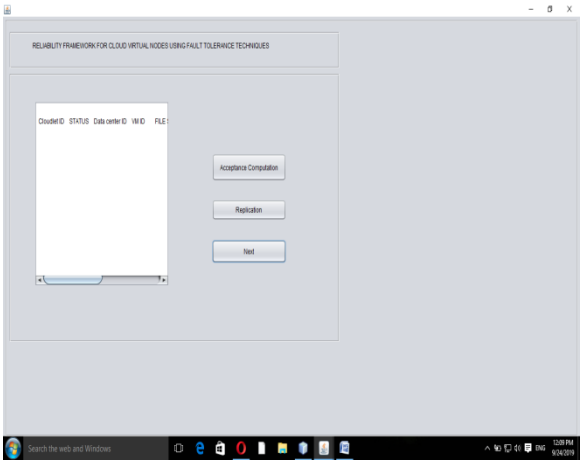

Figure 5 Acceptance Computation

The total time and reliability time is checked for each virtual machine to identify whether the machine performing its task with expected reliability time. Here machines are not performing the results within expected time, so replication will be used.

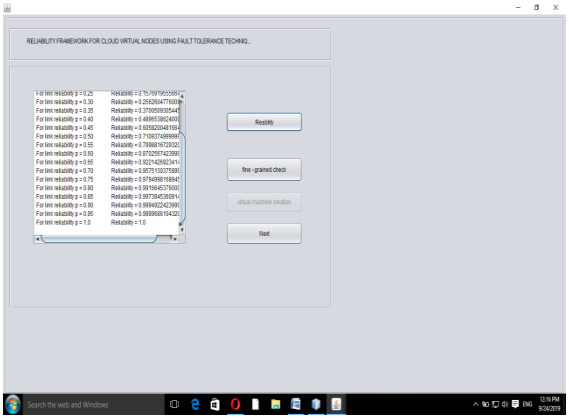

Figure 6 Reliability Structure

In the above structure, reliability of virtual machines are measured.

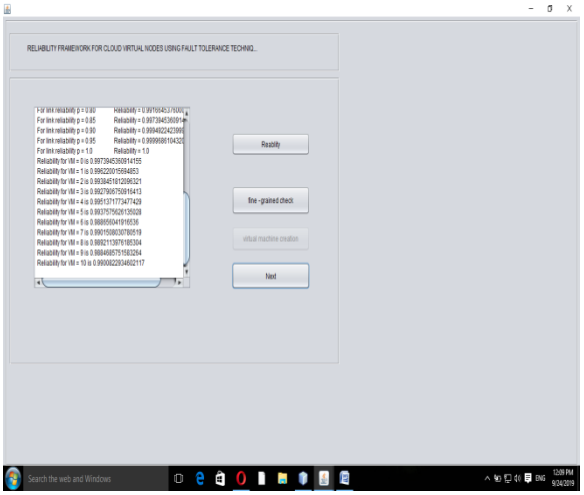

Figure 7 Reliability Structure

In the above structure, fine-grained checkpointing is used to increase the reliability.

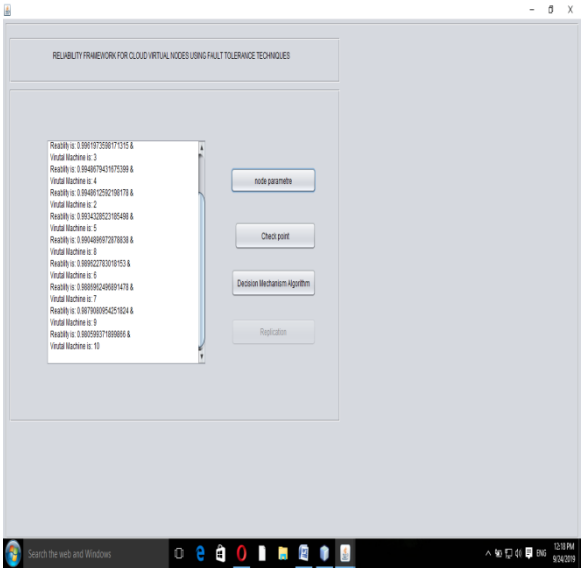

Figure 8 Reliability Structure

In the above structure, reliability is enhanced after using fine-grained checkpointing algorithm.

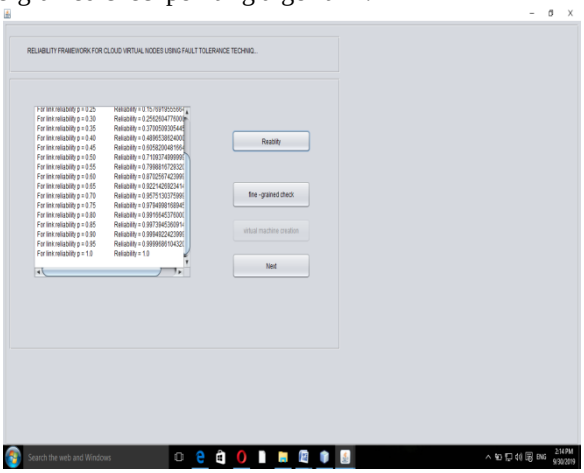

Figure 9 Reliability Framework using fault tolerance technique

In the above structure, reliability is of virtual machines are displayed.

V. CONCLUSION

In the proposed system, n virtual nodes are created and their reliability is measured. The reliability of virtual nodes is enhanced by using replication and fine-grained checkpointing methods. The replication method uses the probability to minimize the faults. The probability of failures decrease as the number of VMs increase to handle user's request. Also while using these methods, failure nodes are also reduced. In the proposed system, execution time is also bridged as compared to the existing methods of fault tolerance.

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