Genetic Algorithm for Virtual Machine Migration in Cloud Computing

Pratibha[1], Dr.Sudhanshu Gaur[2]
[1]*M.Tech Scholar, Prannath Parnami institute of Management and Technology, HISAR*
[2]*Assistant Professor, Guru Jambheshwar University of Science and Technology, HISAR*

Abstract - The cloud computing is the technology which has decentralized nature. Due to such unique nature of the network, load balancing is the major challenge. This research work is based on load balancing in cloud computing. In the previous research work, the improved genetic algorithm is applied for the load balancing but it is analyzed that it has high execution time and resource consumption. The enhancement in improved genetic algorithm is proposed which use only few resources for the load balancing. A tool named MATLAB was used to implement the proposed algorithm. Simulation results shows that proposed is efficient in terms of various parameters

Keywords - *Load balancing, Improved Genetic Algorithm, Fault tolerance*

I. INTRODUCTION

Cloud Computing in nutshell is set or subset of services granting a person or organization access to computing resources like you would on a simple desktop, such resources could be application in a remote location, its storage and all you could in a normal array but as they may exist on a remote location, simple way for you to access them is via cloud services. The user extracts and improves data in this system. The storing of data is done in a centralized structure known as cloud [1]. Cloud is a framework. The service provider offers services to subscribers when they demand those services. This very important aspect is called CSP. CSP is known as "Cloud Service Provider". This implies that user pays for the services that he/she use. Cloud computing is a technology that provides a complex number of applications in various topologies. Every system provides a particular service. It is not required to get information about the service providing system such as locality or pattern of the system. Cloud computing has some fundamental characteristics. These characteristics include virtualization, homogeneity, modern security, on demand scale, minimal cost software, and geological distribution service orientation [2]. In cloud computing, it is possible to use application without installing it. After getting the network access, the client can handle his private files at any place with the help of this technology. In order to provide more competent computing and resource distribution, bandwidth and memory, this technology uses features of centralized storage. Infrastructure as a Service or IaaS is a cloud computing model. Basic storage and computing potentials are provided in the form of consistent services on the network using this model. This model combines servers, storage systems, networking devices, data centre space etc. These tools are used to manage workloads. It is possible for the client to install his/her personal software on the system. Amazon, GoGrid, 3 Tera, and so on are some popular examples of Infrastructure as a Service model. Platform as a Service or PaaS gives access of computational resources. This model can be used to host and design applications and resources [3]. As the name implies this type of cloud computing providers provide the development environment as a service where user can write applications and develop software. Software as a Service (SaaS) model provides an absolute application to the client, as a service on demand. A particular example of the service runs on the cloud. This provides service to numerous end customers. The users should have the access of internet connection to utilize services. Some specified business thread providing particular cloud services can be implemented using this type of cloud model [4]. In cloud computing, this is the most common service model to all the users. This model provides cloud services to the clients through dynamic environment. In order to develop this environment, polled shared physical resources are used. These resources are shared on public network using internet. Numerous users share similar infrastructure. Operations in cloud are carried out in optimal manner using this model. On demand of some particular business, designing and developing of this cloud is performed. Private cloud service provider offers the authorization of its network to the client in a more protected manner. During this process, service providers ensure that the user outside of the network could not get the access of the network. Therefore, in contrast to public cloud, the private cloud provides more security but less flexibility. Compilation of numerous clouds such as private cloud and public cloud is called Hybrid cloud [5]. Every cloud has its own distinctive identity. However, all are clouds are determined as a unit. This cloud provides information and application in standard form. At times, some more storage space is required during working with private clouds; in this case, some public clouds are used. This phenomenon is called

cloud bursting. In this scenario, the business only has to pay for the consumption of additional space. The technique that uses different methodologies to share the entire load of the network between many nodes to make resource use competent and increase response time of the task is known as load balancing. Meanwhile, a state containing some under loaded hubs and over loaded hubs is removed. The consistency and accessibility of the data can be improved through redundancy by using many components rather than a single component to balance load. In order to compute load, some statistics around CPU load, memory consumed, delay or network load [6] are considered. Virtual Machine is a program or an operating system. This is deployed on a virtual space within a host. The deployed virtual machine behaves as a single object to cater request and provide services as a physical medium. Virtual machine behaves as a absolute system in spite of being virtual in a host. In general, a virtual machine is developed in a larger environ called host. Numerous virtual machines can be included within a host. These virtual machines behave as an autonomous object. Genetic Algorithm is developed from the research of cell automata. John Holland and his colleagues developed this algorithm. Basically, Genetic Algorithm is a major research field. This algorithm is a branch of computer science. Solutions related to various optimization problems can be obtained using this algorithm. These algorithms are also called evolutionary algorithms [7]. Developmental science involves various features in this approach. These are inheritance, change, feature determining, and recombination. In the representation of the hereditary calculations the wellness capacity is characterized. The hereditary computation continues to establish the arrangements arbitrarily.

II. LITERATURE REVIEW

Sheetal Karki et al. in 2018 [8] stated that cloud had been identified as the data stored in merged virtual machine. An end user could manage this data with the help of offered services. Cloud Service Providers gave access of services to the users as per their demand. The users had been charged for the subscribed services. Task migration had been considered in this work. In task mitigation, virtual machine got overloaded during the implementation of cloudlet. It was the responsibility of cloud service providers to assign duties to the most suitable virtual machine. The task was mitigated from one virtual machine to other virtual machine in case of the overloading of virtual machine. The task could remain in queue as well. In order to determine this, the threshold and check pointing algorithm could be used. For this purpose, the processing time, power and resource expenditure were minimized.

Sukhpreet Kaur et al. in 2017 [9] said that to assign task to a virtual machine an Improved Genetic Algorithm (IGA) can be used to maximize resource allocation at the same time maintaining optimized energy consumption and provide efficient execution time. At any time IGA ensures that every node is balanced optimally else it defeats the purpose IGA. An Improved Genetic Algorithm (IGA) had been proposed in this study for load balancing. The main purpose of this algorithm was to assign the tasks of customers to the virtual machines (VMs). The suggested algorithm was implemented for maximizing resource use and minimizing the implementation outlay of task and energy use.

WANG Bei et al. in 2016 [10] used Multi-Population Genetic Algorithm (MPGA) for load balancing. The main purpose of this algorithm was to provide a solution of task scheduling issues in cloud system. This algorithm was also employed to prevent premature convergence. The proposed algorithm used the min-min and max-min algorithm to initialize populace for improving the boost research effectiveness. The achieved simulation outcomes revealed that the proposed approach performed better than traditional genetic algorithm in terms of less computational time, less processing costs and load balancing. These results proved that the proposed algorithm efficiently performed task scheduling. In contrast to adaptive genetic algorithm, this approach managed various tasks appropriately

Mahalingam et al. in 2015 [11] proposed an optimized load balancing algorithm based on weight. The main aim of this algorithm was to distribute approaching task among virtual machines evenly. Moreover, a tool named Cloud simulator was used to analyze the performance of suggested algorithm. A comparison of proposed algorithm with accessible Round Robin and EIPR algorithms was performed in this work. The achieved simulation outcomes revealed that the suggested algorithm evenly allotted the load amid virtual machines. In future, the focus would be on removing the issues of deadlocks and virtual machine overloading. A novel rule break strategy could also be implemented within the simulator for developing novel load balancing algorithms.

Keke Gai et al. in 2015 [12] stated that a combinative NP-complex issue was related to the allocation of data tasks to dispersed memories with different sizes. By considering this issue, a new algorithm called Cost-Aware Heterogeneous Cloud Memory Model (CAHCM) was proposed in this work. The main aim of this algorithm was to provide a high level cloud-based heterogeneous memory service. Dynamic Data Allocation Advance (2DA) Algorithm was the major approach that provided support to the proposed algorithm. This algorithm used genetic programming for determining data distribution on the memories based on cloud. Various performance metrics were considered in this work. These metrics included communication costs, cost of data allocation,

energy, and time limits. In the end, analysis of proposed model was done by applying test evaluations. The tested results depicted that the proposed algorithm was quite efficient and practical to be a cost-effective cloud-based solution.

Mr. Mayur S. Pilavare et al. in 2015 [13] sated that a main issue in cloud computing was called Load balancing. In the field of cloud computing, a lot of approaches were proposed for improving load balancing. Genetic Algorithm showed better performance as compared to other algorithms. Genetic algorithm selects virtual machines as input in random manner. Later, processing was performed. Initially, priority algorithm was implemented on the input processors for improving the effectiveness of GA. The primary algorithm was called Logarithmic Least Square Matrix that. The proposed algorithm provided the solution of some issue related to being idle and starvation.

III. RESEARCH METHODOLOGY

The proposed algorithm is the modified version of traditional genetic algorithm. In cloud computing, reducing execution time for task migration is the main aim of this algorithm. Alteration in the mutation calculation points was made to reduce the amount of mitigation. This phenomenon decreases execution time and makes proposed algorithm more consistent as compared to accessible algorithm. The genetic algorithm woks in three phases, the first phase is the initial population in which execution and failure rate of each virtual machine is taken as input. In the second phase, the cross over value is calculated and in the last step, the optimum value is chosen from the multiple values which have least chances of failure. In this work, the enhancement in the improved genetic algorithm is proposed to reduce execution time. In the enhanced improved genetic algorithm following steps are there:

1. **Initial Population:** The initial population is the execution time and failure rate of each virtual machine which is used for the task execution. The resources of virtual machine are known as initial populace. These resources are used to carry out task.
2. **Cross over value calculation:** Under the populace every chromosome x fitness value get explored. According to their fitness value we pick two parent chromosomes from a population, and in general bigger the populace bigger is the fitness value with a crossover possibility exceeds the parents to form a new offspring. If none of the crossover was done, offspring becomes ideal replica of parents. With an offspring possibility recreates new offspring at every locus.
3. **Best value Calculation:** The best value is calculated from the crossover value calculated. Use the new generated populace for a farther run of the algorithm.

Following are the steps implemented in this procedure:

Step 1: Initially, the fixed amount of virtual machines is deployed within the network.

Step 2: The cloudlets are assigned to most capable virtual machines. The virtual machines are selected which has least probabilities of failure and execution time.

Step 3: when fault occurs, then the proposed enhanced improved genetic algorithm plays an important role in the selection of most appropriate virtual machine.

Step 4: The cloudlet is migrated to other virtual machine. The virtual machine implements next cloudlet.

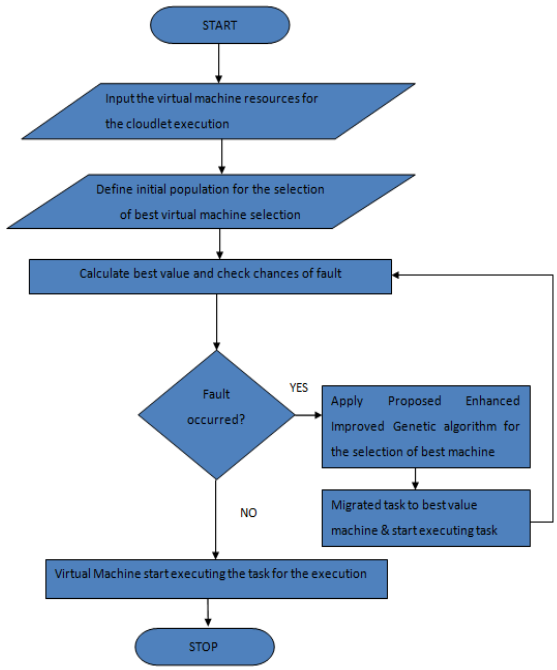

Fig 1: Flowchart of Proposed Improved Genetic Algorithm

IV. EXPERIMENTAL RESULTS

A tool named MATLAB is used for the implementation of proposed approach. The achieved outcomes have been assessed in terms of several parameters.

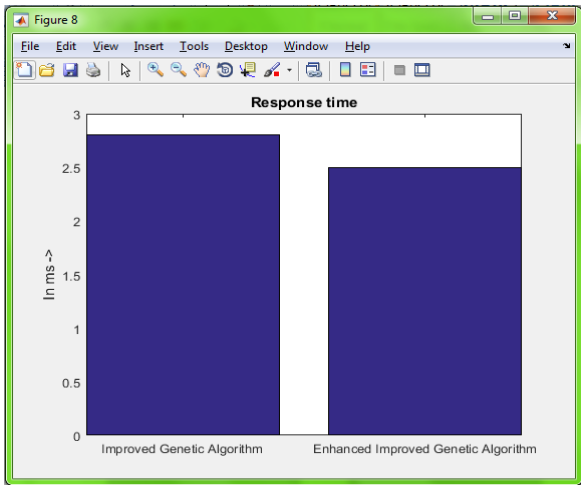

Fig 2: Comparison graph of Response Time

Fig 2 compares the modified genetic algorithm and proposed enhanced improved genetic algorithm in terms of response time for analyzing their performance. In contrast to modified genetic algorithm, the proposed enhanced improved genetic algorithm has less response time.

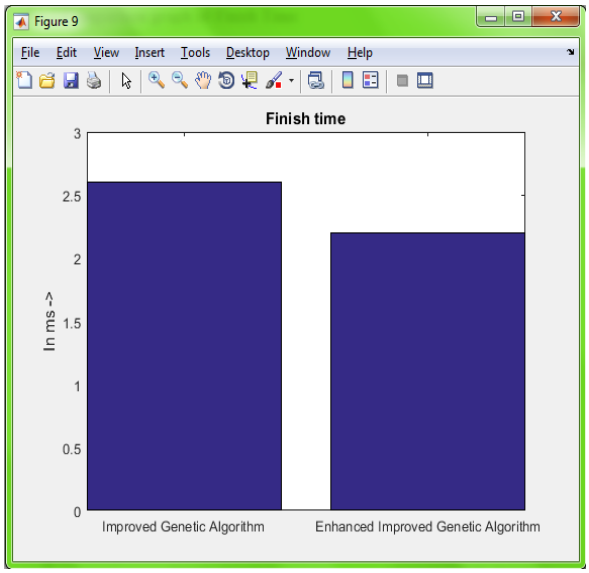

Fig 3: Comparison graph of Finish Time

Fig 3 compares the modified genetic algorithm and proposed enhanced improved genetic algorithm in terms of finish time for analyzing their performance. In contrast to modified genetic algorithm, the proposed enhanced improved genetic algorithm has less finish time

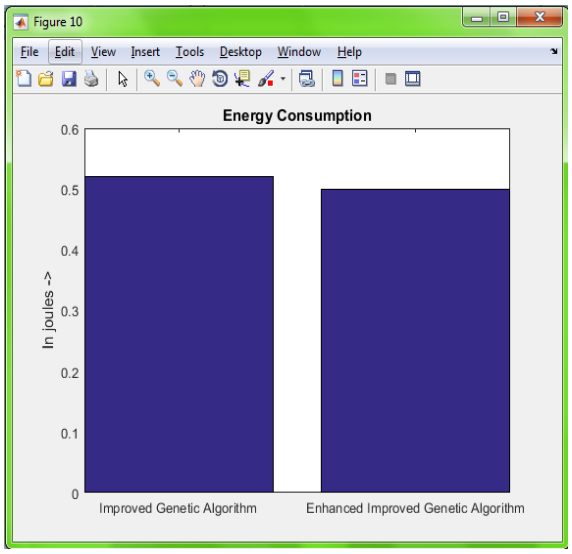

Fig 4: Comparison graph of Energy Consumption

Fig 4 compares the modified genetic algorithm and proposed enhanced improved genetic algorithm in terms of energy consumption for analyzing their performance. In contrast to modified genetic algorithm, the proposed enhanced improved genetic algorithm consumes less energy.

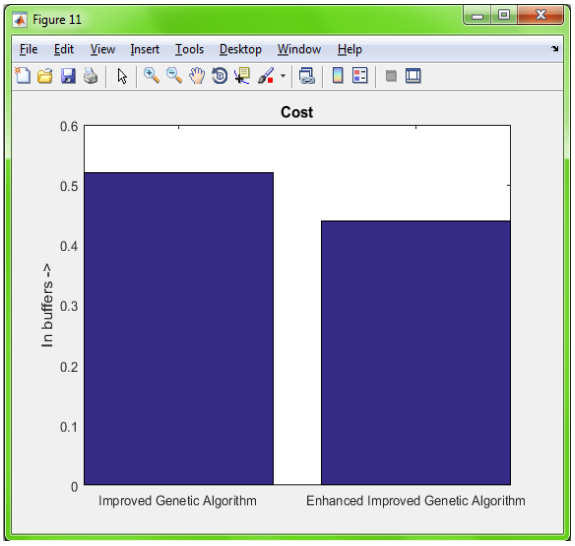

Fig 5: Comparison graph of Cost

Fig 5 compares the modified genetic algorithm and proposed enhanced improved genetic algorithm in terms of cost for analyzing their performance. In contrast to modified genetic algorithm, the proposed enhanced improved genetic algorithm is less costly.

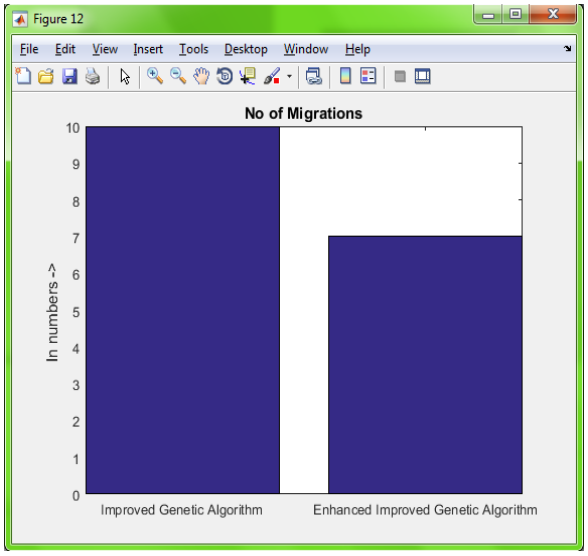

Fig 6: Comparison graph of No of Migrations

Fig 6 compares the modified genetic algorithm and proposed enhanced improved genetic algorithm in terms of number of mitigation for analyzing their performance.. In contrast to modified genetic algorithm, the proposed enhanced improved genetic algorithm has less number of mitigation.

V. CONCLUSION

The cloud computing is dynamic in nature. Cloud network faces several problems due to its dynamicity. The main problem of cloud computing is load balancing. This issue decreases the efficiency of cloud computing. The algorithm proposed in this study for fault detection that carries out virtual machine migration is called enhanced improved genetic algorithm. The improved genetic algorithm performing virtual machine migration is more complex and takes more execution time. Here, an improvement is performed in the enhanced genetic algorithm. This is done to minimize the execution time. The proposed approach is more speedy and reliable. This minimizes the chances of fault occurrence. The proposed and existing algorithms are implemented using MATLAB tool. These algorithms are compared for evaluating their performances. For this purpose, various metrics have been considered. These metrics include response time, finish time, energy consumption, cost and no of migrations. For virtual machine migration, the proposed enhanced improved genetic algorithm performs better than existing improved genetic algorithm as per the conclusion.

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