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PERFORMANCE ANALYSIS OF TASK SCHEDULING USING HYBRID GENETIC MODIFIED WHALE OPTIMIZATION ALGORITHM IN CLOUD COMPUTING

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Abstract

Cloud computing plays a vital role, which is used to access computing resources and information online. There are a lot of challenges in accessing cloud computing systems. One of the major challenges among these is resource Management which includes scheduling, allocation, and sharing. In this paper, the Hybrid Genetic Modified Whale optimization algorithm which is a combined Genetic and Modified Whale optimization algorithm to analyze the performance of the cloud computing system such as task completion time, execution cost, speedup, and efficiency with proper allocation and sharing of resources The performance of the proposed algorithm is compared with Genetic algorithm and Whale optimization algorithm. The main target of this Proposed system is to reduce the completion time of the task by increasing the speed. Cloud Sim environment tool kit is used for the testing of the proposed system.

Keywords: Cloud computing, Task scheduling, GA (Genetic Algorithm), HGMWOA (Hybrid Genetic Modified Whale optimization algorithm), VM (Virtual Machine).

I. Introduction

Since internet technologies have developed, one of the emerging fields is cloud computing. Cloud computing is defined as a type of distributed system, that consists of the collection of data and can be accessed through the internet. A lot of challenges occurred during task scheduling [I] time and resource sharing and allocation. The main objective of this paper is to develop a Hybrid Genetic Modified Whale optimization algorithm for task scheduling to reduce the task completion time and increase the speed and efficiency [V] by proper resource allocation. In this paper, related work is discussed in Section II. Proposed work is discussed in section III. In Sections IV and V, Experimental results and future scope are discussed.

II. Experimental Study

Many studies are being conducted in the field of cloud computing systems. Numerous obstacles exist in diverse domains. The main problem with task scheduling is task completion time and speed. Our suggested system offers a remedy that enhances task scheduling performance.

The following research papers are taken for the analysis.

Kun Li et al., proposed an Improved Whale Optimization Algorithm. In this work, Utilizing system resources and reducing system load, the algorithm enhances the effectiveness of task scheduling.
Zhihao Peng et al., proposed a Map Reduce framework that can be used to run genetic algorithms in parallel for static tasks. The primary goal of the work is to combine the HEFT and Genetic algorithms to divide the main task into several smaller tasks and assign them to different processors to maximize operation speed.

Ahmed Y. Hamed et al., "Task Scheduling Optimization in Cloud Computing by Jaya Algorithm" Faculty of Computers and Artificial Intelligence, In this paper Jaya algorithm improves the efficiency and speedup by scheduling subtasks to the available Virtual Machines.

An Ning Zhang et al., proposed a task Scheduling using the Advanced Phasmatodea Population Evolution Algorithm. This Algorithm balances the optimization and Exploration capabilities of the cloud environment**.**

Abdel-Basset et al., proposed a Novel WOA for Cryptanalysis, In this paper, the algorithm optimizes the task completion time of an analogue circuit designed for an automotive application.

Xuan Chen et al., proposed an algorithm called WOA that optimizes task scheduling in a cloud computing system.

Jang et al.,, "The study of genetic algorithm-based task scheduling for cloud computing," provides the complete details about the genetic algorithm.

III. Proposed Method

In a cloud computing system, cloud providers should provide not only an optimal solution but also should guarantee the best throughput. To provide the best possible solution, the cloud needs the best algorithm to execute the task.

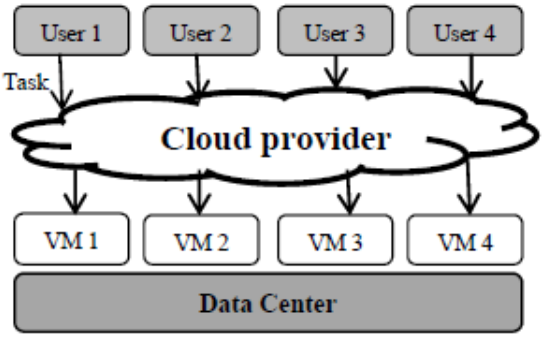

Fig 1. Task scheduling Principle

Fig 1 Shows how the cloud provider connects the user's Virtual Machines and also the data center. The data centre contains all the information. If the user wants to access multiple data from the data centre or multi-users want to share the information is called a task. Here, the scheduling of each task plays a vital role. There are a lot of algorithms available for the scheduling of tasks in cloud computing. The proposed algorithm called the "Hybrid Genetic Modified Whale optimization algorithm" is a new algorithm that provides a solution by combining the Genetic algorithm with the Modified Whale optimization algorithm**.**

Whale optimization algorithm

Whale optimization is a new algorithm which provides a solution for various cloud computing problems. The MWOA provides a solution for a lot of constrained and unconstrained Problems of real-time applications without altering its structure. There are three operators such that prey, encircling prey, and bubble-net foraging behavior of humpback whales. This algorithm initially starts with a set of random solutions. In each and every iteration, the search agent updates the position of the current search agent concerning the randomly chosen search agent or the best solution obtained at that time. Fig 2 shows the Whale optimization algorithm in task scheduling The WOA also has some drawbacks compared to the other algorithms in terms of its convergence speed and accuracy.

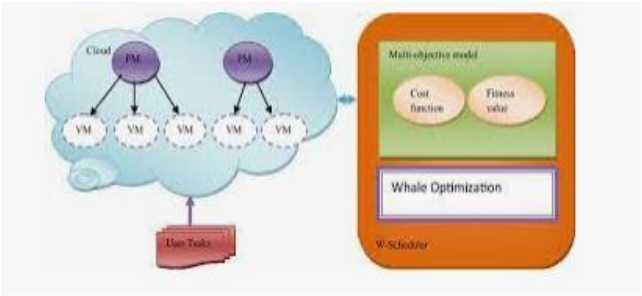

Fig 2. Whale optimization algorithm in task scheduling

Genetic Algorithm

Genetic Algorithm is an algorithm that is a biological-based concept and it has the main principle of Initial population, Fitness function, Selection. Crossover and mutation[16]. Fig 3 shows the flowchart of the Genetic Algorithm.

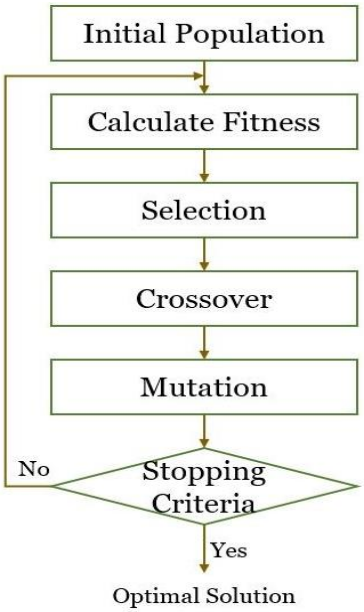

Fig 3. Genetic Algorithm

Proposed Hybrid Genetic Modified Whale Optimization Algorithm

Task scheduling is an important issue in cloud computing. In the existing system, task scheduling focuses only on certain parameters either execution time or make span. To overcome this issue, the proposed paper uses a Genetic algorithm along with a Whale optimization algorithm. In this algorithm, the task scheduler calls the Genetic scheduling function during every scheduling cycle [V]. The genetic algorithm (GA) is one of the evolutionary approaches used to solve complex problems quickly. The main drawback of the GA is its slow response to a higher number of tasks. To overcome these issues, The proposed algorithm is introduced. This algorithm overcomes the drawbacks of the others and provides a solution for TSP. The proposed Hybrid genetic Modified Whale optimization algorithm combined with genetic algorithm improves combined mutation operator improves the no.of tasks for scheduling with variable. This scheduling function creates a set of tasks along with the MWOA algorithm and measures the performance of each task with user satisfaction along with the availability of the Virtual Machine. Fig.4 shows the flowchart of the proposed Hybrid genetic Modified Whale optimization algorithm.

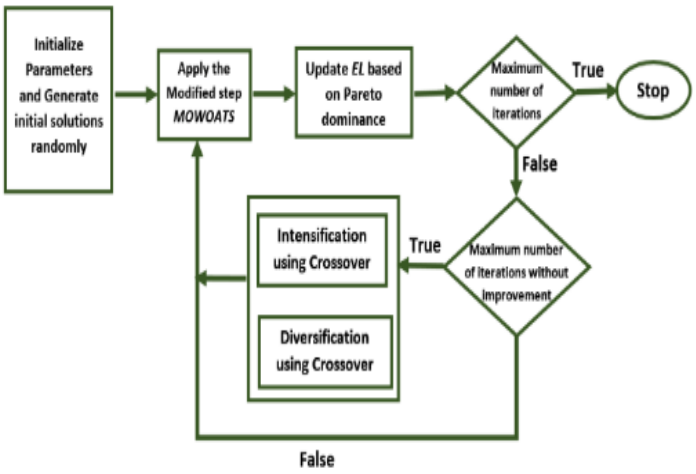

Fig 4. Hybrid genetic Modified Whale optimization algorithm

The experimental result shows the efficiency and it is compared with Normal Genetic Algorithm and Particle swarm optimization.

Step 1: Determination of parameters, random population initialization, and iteration count. The population provides the solution during the first iteration.

Step 2: During the first step of the Genetic algorithm, random chromosomes are selected for the crossover operation. And others are selected afterwards. During the second step, Selected chromosomes with 90% of single-point crossovers produce the offspring. During the third step, a Mutation operation takes place to make the changes in the chromosomes. HGMWOA Algorithm, the probability of the mutation is calculated using the formula (i.e,1/Number Of Tasks)

Step 3: Process using the MWOA method.

$$X(t+1)=\begin{cases} p^{*}X*(t)- AD & p < 1.0 \\ p^{*}D\cos(2\pi t)+ X*(t) & p \geq 1.0 \end{cases} \quad (1)$$

Where,

X=No.of tasks

t=Time taken to execute the task

D=delay time

Random sequence p is a numeric value, and it is limited up to 2.D=Y*(t)-Y(t) and the distance of i th whale, b is a constant and a represents iteration .A=(CY*(t)-Y(t)) , B=2ar-a, C=2r, and r denotes random vector. Y represents the whale's population and A represents the present search agent.

Step 4: In this process is continued, when the termination criterion is reached.

Algorithm :

Pseudo codes of MWOA
Set the whales population $Y(i = 1,2,3,...,n)$
Set a,A,p and C
Compute the fitness of each search agent $Y*$ = *the best search agent*
Procedure MWOA ($Population$,,A,C,p,$Max\ Iter$,,) $t = 1$
while $t \leq Max$ Iter **do**
for each search agent **do**
if $|A| \leq 1$ then
Update the position of the current search
agent by the equation (1)
else if $|A| \geq 1$ **then**
Take a random search agent Xr and
Bring up to date the position of the current agent
end if
end for
Bring up to date a,A,p and C
Bring up to date $Y*$ if there is a better solution $t = t + 1$
end while
return $Y*$
end procedure

III. Experimental Result

The Experiment was carried out using the Improved HGMWOA algorithm, and various parameters were also calculated such as Completion time, Execution cost, Speed up, and Efficiency. The results are compared with the GA and WOA algorithm

Technical Parameters & Requirements

The system requirement with specifications to carry out this experiment is given in Table 1 along with the cloud sim simulation tool

Table 1: HGMWOA Parameters

Max.No. of Iteration	100
Crossover operator	Single point
Crossover probability	90%
Mutation operator	Random
Mutation Probability	1/No.of. Tasks
Execution time	10 Secs

Table 2: HGMWOA Algorithm Parameters

Number of VM	10
Tasks count	80
RAM (MB)	4096
Bandwidth (Mbps)	1000-1500
MIPS	300-600
No.of Processors	10

Completion time & Execution cost

Tables 3 & 4 show the task completion time and execution cost of the HGMWOA algorithm for 10VM. The execution cost can be calculated as follows.

Total Execution cost =((Task length* Cost per second) No of VMs) + Processing cost

Table 3: Completion time of HGMWOA Algorithm Parameters with 10 VM

Algorithm	Number of Virtual Machines	No. of tasks	Completion time
GA	10	20	154.6
WOA			265.3
HGWOA			132.2
GA		40	495.2
WOA			415.6
HGWOA			256.2
GA		60	752.4
WOA			668.2
HGWOA			456.2
GA		80	867.6
WOA			714.2
HGWOA			658.9

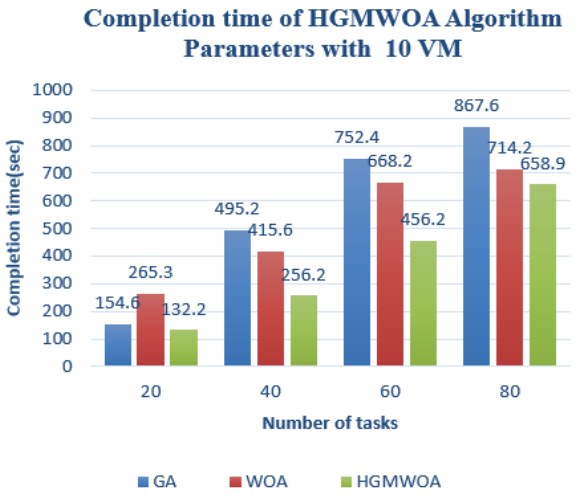

Table 4 : Execution cost of HGMWOA Algorithm Parameters with 10VM

Algorithm	Number of Virtual Machines	No. of tasks	Execution cost
GA	10	20	2569.21
WOA			2514.36
HGWOA			2869.33
GA		40	6589.32
WOA			6358.28
HGWOA			5986.25
GA		60	9568.54
WOA			7569.23
HGWOA			10586.22
GA		80	12587.69
WOA			11589.65
HGWOA			10896.68

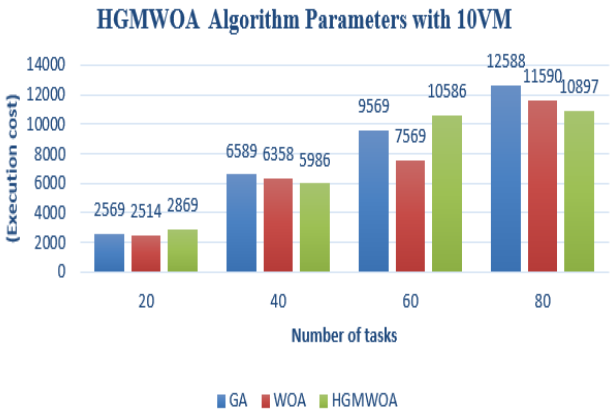

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Table 5 : Speedup of HGMWOA Algorithm Parameters with 10VM

Algorithm	Number of Virtual Machines	No. of tasks	Speedup
GA	10	20	0.165
WOA			0.253
HGWOA			0.356
GA		40	0.185
WOA			0.286
HGWOA			0.387
GA		60	0.256
WOA			0.326
HGWOA			0.498
GA		80	0.432
WOA			0.568
HGWOA			0.856

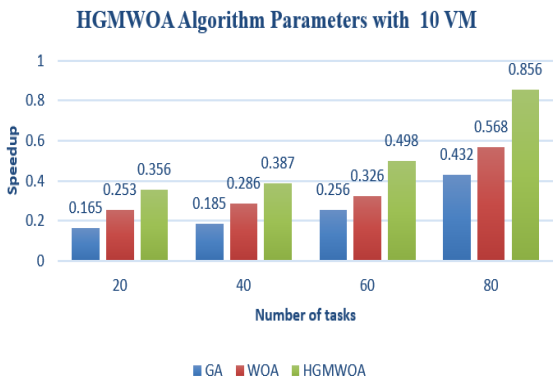
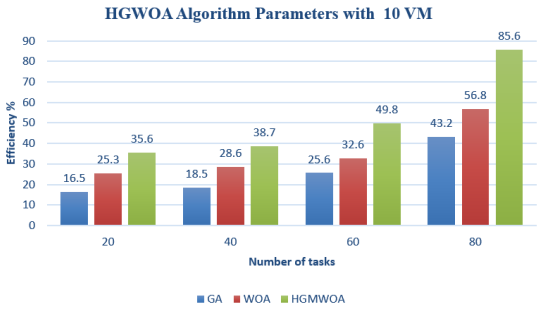


Table 6 . Efficiency of HGMWOA Algorithm Parameters with 10VM

Algorithm	Number of Virtual Machines	No. of tasks	Efficiency %
GA	10	20	16.5
WOA			25.3
HGMWOA			35.6
GA		40	18.5
WOA			28.6
HGMWOA			38.7
GA		60	25.6
WOA			32.6
HGMWOA			49.8
GA		80	43.2
WOA			56.8
HGMWOA			85.6



IV. Conclusion

In this study, the performance of task scheduling in cloud computing was analyzed using the Hybrid Genetic Modified Whale Optimization Algorithm (HGMWOA). Various parameters, including completion time, execution cost, speed, and efficiency, were evaluated during the testing phase with 10 virtual machines. The simulation results were compared against current algorithms such as GA and WOA. This proposed HGMWOA demonstrated superior performance, meeting or exceeding expectations in comparison to the existing systems. The findings suggest that HGMWOA is a viable solution for efficient task scheduling in cloud computing environments. Future research could explore the impact of increasing the number of tasks and virtual machines to further determine the algorithm's performance in terms of completion time, execution cost, speedup, and efficiency.

Conflict of interest :

All authors declare that there is no conflict of interest in this work.

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