TASK SCHEDULING TECHNIQUES FOR CLOUD COMPUTING ENVIRONMENT – A LITERATURE REVIEW

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***Abstract*— These days, cloud computing turns out to be well known and prominent among the users on account of its different highlights. The computing resources are taking on the lease/rent when required. In this way, cloud computing depends on the on-request technique or pay-as-you-go model. The environment of cloud computing gives a figment of endless computing resources to cloud users. These computing resources are expanded or diminished by the requests of the user on the cloud. In this way, to accomplish effective use, appropriate task scheduling is essential. In this paper, the literature survey is prepared with the different task scheduling techniques for improving the QoS in cloud computing by different research works done in this equivalent field.**

***Keywords*— Cloud computing, Task Scheduling, Optimization techniques, Quality of Service**

I. INTRODUCTION

Cloud computing creates another computing perspective, which intends to give solid, changed, and QoS (Quality of Service) guaranteed dynamic computing circumstances for end-customers [1]. Grid computing, parallel processing, and Distributed preparing together built as cloud computing. The basic guideline of cloud computing is that customer information isn't taken care of locally, but it may take care of on the server farm of the web. The associations which give cloud computing service could supervise and keep up the movement of these server farms. The customers can get the opportunity to take care of information at whatever point by using the Application Programming Interface (API) gave by cloud providers through any terminal equipment related to the web. Programming and equipment services are accessible for the most part open and business markets. The services gave by service providers can be everything, from the product or stage, foundation, resources. Each such service is independently called Software as a Service (SaaS) or Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) [2]. There are different points of interest in cloud computing, the most fundamental ones being lower costs, re-provisioning of resources, and remote availability. Cloud computing cuts down the expense by keeping away from capital utilization by the organization in renting the physical framework from an outsider supplier. On account of the versatile idea of cloud computing, we can quickly get to more resources from cloud providers when we need to grow our business. The remote openness empowers us to get to cloud services from anyplace whenever. To pick up the maximum level of the above-referenced points of interest, the services offered similarly as resources should be assigned ideally to the applications running in the cloud.

II. TYPES OF TASK SCHEDULING

The different types of task scheduling in a cloud computing environment are:

- *User-level scheduling:* User level scheduling comprises of market-based and auction-based scheduling. FIFO scheduling, priority-based, non-pre-emptive scheduling, etc., are used in user-level scheduling.

- *Cloud Service Scheduling:* Cloud service scheduling is ordered at the user level and framework level. At the user level, it mainly considers the service to issues between the supplier and the user. At the framework level, scheduling and resource the executives are finished. Notwithstanding ongoing fulfillment, fault tolerance, reliability, resource sharing, and QoS parameters are likewise contemplated.
- *Static and Dynamic Scheduling:* Static scheduling licenses pre-bringing of the required information and pipelining of far off phases of task execution. Static scheduling forces the least runtime overhead. If there should arise an occurrence of dynamic scheduling, data of the activity parts or task isn't known previously. Along these lines, the execution time of the task may not be known, and the distribution of tasks is done uniquely as the application executes.
- *Heuristics Scheduling:* In a cloud environment, heuristic-based scheduling can be done to optimize results. Heuristic methods can build more accurate results.
- *Workflow Scheduling:* For the administration of work process execution, the work process schedule is finished. Continuous Scheduling: Real-Time Scheduling in cloud condition is done to build the throughput and to diminish the typical reaction time as opposed to complying with a time constraint.

III. LITERATURE REVIEW

Shah-Mansouri, Hamed, Vincent WS Wong, and Robert Schober [1] considered the accompanying issues in Mobile Cloud Computing (MCC) frameworks: (I) which tasks ought to be offloaded to cloud servers? (ii) And what is the typical cost of cloud services?. The creators further proposed an algorithm utilizing convexification and double base techniques to alleviate the non-convexity. Through numerical examinations, the creators explored the versatile users' conduct and the Cloud Service Providers (CSP's) evaluating system.

Kong, Weiwei, Yang Lei, and Jing Ma [2] proposed a novel versatile virtual machine (VM) resource scheduling algorithm dependent up for sale system is introduced to beat the issue of VM scheduling in the cloud computing condition by considering different components including system data transmission and sale cutoff time.

Mama, Juntao, et al. [3] proposed a novel robust task scheduling algorithm dependent on improved genetic algorithm. Based on the genetic algorithm, the proposed algorithm gives full thought to the dynamic qualities of the cloud computing condition. The CloudSim recreation stage is chosen for reproduction; trial results show that the proposed algorithm can adequately improve the throughput of cloud computing frameworks, and can altogether lessen the execution time of task scheduling.

Verma, Manish, et al. [4] presented an effective resource demand prediction and allocation framework in multi-tenant service clouds. The massive commitment of the proposed structure is that it groups the service occupants according to whether their resource necessities would increment or not; founded on this characterization, our system organizes forecast for those service inhabitants in which resource request would increment, along these lines limiting the time required for expectation.

Bala, Anju, and Inderveer Chana [5] proposed a priority-based task scheduling approach has been recommended that organizes the work process tasks dependent on the length of the guidelines. The proposed scheduling approach organizes the tasks of cloud applications as indicated by the points of confinement set by six sigma control graphs dependent on potent edge esteems.

Yang, Xianda, et al. [6] proposed a multi-resource virtual machine distribution algorithm named Dominant Resource First Allocation (DRFA). This paper intended to boost resource use in different cloud computing conditions. By computing the predominant resource under numerous resource measurements, our proposed algorithm DRFA can make the full favorable position of the heterogeneous physical resources.

Saxena, Deepika, R. K. Chauhan, and Ramesh Kait [7], discussed the proposed algorithm, the creators have characterized and gathered all tasks as cutoff time based and minimum cost-based imperatives, and

after robust optimization, the need for decency is applied. Here various need lines (high, mid, low) are executed in cooperative design according to loads allocate to them.

Tao, Dan, et al. [8] In this paper, the authors had initially proposed another Dynamic Hadoop Cluster on IaaS (DHCI) design, which incorporates four key modules: a scheduling module, observing module, virtual machine the board module and virtual machine movement module. Also, the creators introduced a heap input based resource scheduling plan. Thirdly, the creators reused the strategy for the VM movement and proposed a forceful relocation based information territory plot.

Djebbar, Esma Insaf, and Ghalem Belalem [9] proposed two procedures for task scheduling and resource allotment for high information in Cloud computing. The primary goal is to improve information the executives in a virtual machine in Cloud computing and streamline the absolute execution time all things considered.

Pop, Florin, and Maria Potop-Butucaru [10] this paper presented propels in virtual machine task and position, multi-objective and multi-limitations work scheduling, resource the executives in united Clouds and complex situations, the dynamic topology for information appropriation, work process execution improvement, vitality productivity techniques and confirmation of Service Level Agreements.

Wang, Xiaoli, Yuping Wang, and Yue Cui [11] propose another vitality mindful multi-work scheduling model dependent on MapReduce. First, the variety of vitality utilization with the exhibition of servers is considered; second, since arrange transfer speed is a moderately constrained resource in cloud computing, 100%data territory is ensured; to wrap things up, taking into account that task-scheduling systems depend straightforwardly on information position strategies, the creators define the issue as a whole number bi-level programming model. It merits seeing that there are generally countless tasks to be planned for the cloud, so this is a vast scale optimization issue. To comprehend it proficiently, a neighborhood search administrator is explicitly planned, in light of which, a bi-level genetic algorithm is proposed in this paper.

Mousavi, Seyedmajid, Amir Mosavi, and Annamária R. Varkonyi-Koczy [12] proposed, a mixture load offsetting algorithm with blend of Teaching-Learning-Based Optimization (TLBO) and Gray Wolves Optimization algorithms (GWO), which can well contribute in augmenting the throughput utilizing very much adjusted burden crosswise over virtual machines and beat the issue of trap into nearby ideal. The half breed algorithm is benchmarked on eleven test capacities, and a near report is directed to check the outcomes with particle swarm optimization (PSO), Biogeography-Based Optimization (BBO), and GWO.

Singh, Aarti, Dimple Juneja, and Manisha Malhotra [13] this examination proposes another Agent-based Automated Service Composition (A2SC) algorithm, including demand handling and robotized service organization stages. It isn't answerable for looking through extensive services yet also considers diminishing the expense of virtual machines that are devoured by on-demand services only.

Sarkhel, Preeta, Himansu Das, and Lalit K. Vashishtha [14] proposed three different task-scheduling algorithms, for example, Minimum-Level Priority Queue (MLPQ), MIN-Median, Mean-MIN-MAX which intends to limit the makespan with most significant usage of the cloud. The consequences of the proposed algorithms are additionally contrasted and some current algorithms, for example, Cloud List Scheduling (CLS) and Minimum Completion Cloud (MCC) Scheduling.

Mohanty, Subhadarshini, et al. [15] In this paper, a heap adjusting algorithm utilizing Multi Particle Swarm Optimization (MPSO) has been created by using the advantages of PSO algorithm. The proposed approach expects to limit the task overhead and augment the resource use in a homogenous cloud condition. Execution correlations are made with the Genetic Algorithm (GA), Multi GA, PSO, and other famous algorithms on various estimates like makespan count and resource usage.

Priya, V., and C. Nelson Kennedy Babu [16] proposed a strategy called Moving Average-based Fuzzy Resource Scheduling (MV-FRS) for virtualized cloud conditions to improve the scheduling of resources through virtual machines. At first, the MV-FRS technique begins by foreseeing the resource necessities. At that point, a proportion of connections between the accessibility of resources and the prerequisites of resources are made. At long last, a fuzzy control hypothesis is intended to achieve framework openness between user cloud prerequisites and cloud users' resource accessibility.

Suri, P. K., and Sunita Rani [17] The proposed scheduling model developed for cloud applications in multi-cloud condition and actualized in three stages (minimization, gathering and positioning and execution) and thought about standard holding up time, average turnaround time, completion time and makespan as execution parameters. In this scheduling model, the execution time of tasks in cloud applications is created through typical dissemination and exponential conveyance. The positioning of tasks depends on Shortest Job First strategy (SJF), and results are compared with other ranking methods based upon Largest Processing Time First (LPTF) and First Come First Serve (FCFS).

Seth, Sonam, and Nipur Singh [18] proposed a resource allotment model based on dynamic parameters. This technique, dynamic edge-based powerful resource assignment, can enhance the resource use and time.

Singh, Poonam, Maitreyee Dutta, and Naveen Aggarwal [19] This paper achieved an audit of utilizing meta-heuristics techniques for scheduling tasks in cloud computing. It displayed the scientific classification and relative survey on these algorithms. Orderly investigation of task scheduling in cloud and framework computing is displayed dependent on swarm knowledge and bio-propelled techniques. This work will empower the perusers to choose an appropriate methodology for recommending better plans for scheduling the user's application.

Alla, Hicham Ben, Said Ben Alla, and Abdellah Ezzati [20] proposed another Dynamic Priority-Queue (DPQ) approach dependent on a hybrid multi-criteria basic leadership (MCDM) Differential Evolution (DE), and specifically ELECTRE III. Moreover, to plan the tasks, the writers presented a hybrid meta-heuristic algorithm dependent on PSO and Simulated Annealing (SA). The proposed DEELDPQ-SAPSO approach has been approved through the CloudSim test system.

Latiff, Muhammad Shafie Abd, Syed Hamid Hussain Madni, and Mohammed Abdullahi [21] proposed a powerful bunching class title algorithm (DCLCA) scheduling system for fault tolerance attention to address cloud task execution which would think about the current accessible resources and diminish the untimely disappointment of self-ruling tasks.

Seth, Sonam, and Nipur Singh [22] The issue of resource use in heterogeneous computing framework has been contemplated with varieties. Scheduling of free, noncommunicating, variable-length tasks in the worry of CPU usage, low vitality utilization, and makespan utilizing dynamic heterogeneous most limited employment first (DHSJF) model is talked about in this paper. Tasks are planned for such a way to limit the whole CPU time and in general framework execution time or makespan.

Juarez, Fredy, Jorge Ejarque, and Rosa M. Badia [23] proposed a consistent, unique scheduling framework to execute productively task-put together applications with respect to conveyed computing stages to limit the vitality utilization. Scheduling tasks on multiprocessors is a surely understand NP-difficult issue, and ideal arrangement of these issues isn't attainable, we present a polynomial-time algorithm that consolidates a lot of heuristic guidelines and a resource assignment system to get excellent arrangements on a moderate time scale.

Arya, K. S., P. V. Divya, and KR Remesh Babu [24] In this paper, a dynamic strategy for task portion and resource assignment is acquainted with lessen virtual machine movements and execution time. The proposed algorithm is recreated, and results are contrasted and the current algorithm.

Agarwal, Mohit, and Gur Mauj Saran Srivastava [25] proposed the cuckoo search-based task scheduling approach, which helps in appropriating the tasks effectively among the available virtual machines (VM's) and keeps the general reaction time (QoS) minimum. This algorithm doles out the tasks among the virtual machines based on their handling power, i.e., million directions for each second (MIPS) and the length of the tasks.

Moazemi, Setareh, and Mehdi Javanmard [26] this paper proposed a virtual vitality virtualization movement system that transmits live VMs from a functioning hub to another dynamic hub. The proposed procedure utilizes the life story enlivened destroyed optimization method to locate the best hub for over-relocating VMs to accomplish vitality productivity in cloud server farms. This advances vitality proficiency through the ideal relocation of VMs, accordingly improving the level of resource use.

Alla, Hicham Ben, et al. [27] proposed two-hybrid metaheuristic algorithms, the first utilizing Fuzzy Logic with the Particle Swarm Optimization algorithm (TSDQ-FLPSO), the subsequent one utilizing Simulated Annealing with Particle Swarm Optimization algorithm (TSDQ-SAPSO).

Xu, Xiaolong, et al. [28] proposed a unique resource designation technique named DRAM for load adjusting in haze conditions. A framework system for mist computing and the heap balance examination for different sorts of computing hubs are exhibited first. At that point, a comparing resource portion strategy in the haze condition is structured through static resource assignment and dynamic service relocation to accomplish the heap balance for the haze computing frameworks.

Fatima, Aisha, et al. [29] In this article, a resource distribution model is displayed to enhance the resources in private structures. The entire world is arranged into six areas relying upon its mainlands. The haze helps cloud computing available on edge arrange. It additionally spares information incidentally and sends it to the cloud for lasting stockpiling. Every mainland has one mist which manages three bunches having 100 structures. Microgrids (MGs) are utilized for the excellent power dispersion among the purchasers. Particle Swarm Optimization with Simulated Annealing (PSOSA) is utilized for load adjusting of Virtual Machines (VMs) utilizing numerous service representative strategies.

Toosi, Adel Nadjaran, Richard O. Sinnott, and Rajkumar Buyya [30] proposed another resource provisioning algorithm to help the cutoff time necessities of information escalated applications in hybrid cloud situations. To assess the proposed algorithm, we actualize it in Aneka, a stage for creating adaptable applications on the Cloud.

Xavier, VM Arul, and S. Annadurai [31] This paper concentrated on limiting in general makespan with compelling burden adjusting by displaying the swarm knowledge of social creepy crawly with fierce idleness weight-based arbitrary determination. The proposed algorithm counteracts the neighborhood assembly and investigates the worldwide smart looking in finding the best advanced virtual machine for the user task among the arrangement of virtual machines with minimum makespan and adjusted resource use.

Marahatta, Avinab, et al. [32] In this reading, a unique task and scheduling plan, specifically, the vitality mindful fault-tolerant powerful scheduling plan (EFDTS), is created to coordinately streamline resource usage and vitality utilization with a fault-tolerant instrument. In the task plot, a task characterization strategy is created to segment the following tasks into various classes and afterward designate them to the most intelligent virtual machines dependent on their classes to diminish the mean reaction time while thinking about vitality utilization. Replication is utilized for the fault tolerance to limit the task dismissal proportion brought about by machine disappointment and postponement. A versatile resource provisioning system is structured with regards to fault-tolerance to improve resource use and vitality productivity. Besides, a movement strategy is built up that can, at the same time, improve resource use and vitality productivity.

Tang, Hengliang, et al. [33] propose the dynamic resource portion algorithm for the cloud-edge condition. The dynamic resource distribution algorithm comprises of the resource scheduling algorithm and the resource coordinating algorithm. In the resource scheduling algorithm, a resource scheduling issue can be acquired by the put-away punishment of scheduling substance, the benefit of scheduling substance, and the transmission cost of scheduling substance. At that point, the tabu hunt algorithm is applied to locate the ideal answer for the resource scheduling issue.

Alkhalaileh, Mohammad, et al. [34] proposed a powerful resource allotment model to plan information severe applications on incorporated calculation resource conditions made out of cell phones, cloudlets, and open cloud, which we allude as hybrid Mobile Cloud Computing (hybrid-MCC). The distribution procedure depends on a framework model considering various parameters identified with the application structure, information estimate, and system arrangement.

Nayak, Biswajit, Sanjay Kumar Padhi, and Prasant Kumar Pattnaik [35] Mapping can be conceivable when you recognize what tasks are booked or when you don't have the foggiest idea what tasks are

planned. If it is known, at that point, it just requires to pick the way with the goal that it tends to be mapped accurately else, it needs to think about changing conditions.

Kaur, Simranjit, et al. [36] Workflow scheduling concerns the mapping of complex tasks to cloud resources by considering different Quality of Service necessities. Intemperance of consistent multiplication in the investigation of cloud computing, it has gotten stringent to locate the best possible scheduling plan for the execution of the work process under user determinations. This paper likewise featured future research difficulties with a mean to encourage more research in the domain of work process scheduling as an optimization task.

Nayak, Suvendu Chandan, et al. [37] In this article, the writers propose a novel refilling based task scheduling algorithm to plan cutoff time-based tasks. The proposed methodology plans the number of tasks with no leader. An extra line and the present time of the framework is actualized to improve the scheduling execution. It performs sufficiently as far as many leases scheduling and resource utilization.

Selvakumar, An., and G. Gunasekaran [38] Load adjusting is one of the significant worries in cloud computing, and the primary reason for it is to fulfill the prerequisites of users by disseminating the heap equally among all servers in the cloud to boost the use of resources, to build throughput, give excellent reaction time and to diminish vitality utilization. To streamline resource allotment and guarantee the quality of service, this article proposes a novel methodology for load-adjusting dependent on the upgraded insect province optimization.

Prassanna, J., and Neelanarayanan Venkataraman [39] Threshold Based Multi-Objective Memetic Optimized Round Robin Scheduling (T-MMORRS) Technique is proposed in this exploration work. From the outset, user demands are sent to the cloud server. From that point onward, T-MMORRS Technique utilizes a burst finder to decide the remaining task at hand condition as typical or that which is bursty. In light of the burst locator result, at that point, T-MMORRS Technique adjusts the two distinctive burden adjusting algorithms for effectively scheduling the user tasks. The T-MMORRS Technique picks Threshold Multi-Objective Memetic Optimization (TMMO) in typical remaining burden circumstance and Weighted Multi-Objective Memetic Optimized Round Robin Scheduling (WMMORRS) in burstiness outstanding task at hand state.

Panda, Sanjaya K., and Prasanta K. Jana [40] In this paper, the authors put forward an Energy-Efficient Task Scheduling Algorithm (ETSA) to address the negative marks related to task union and scheduling. The algorithm ETSA considers the completion time and unrestricted use of a task on the resources and pursues a standardization methodology to settle on a scheduling choice.

IV. NEED FOR SCHEDULING

In cloud computing, users may use a vast number of virtualized resources, and it is incredible for everyone to choose each task manually. Because of commercialization and virtualization, cloud computing started the task scheduling multifaceted nature to the virtual machine layer by using resources. Subsequently, to relegate the resources to each task proficiently and adequately, scheduling assumes a significant job in cloud computing.

V. CONCLUSION

Task scheduling assumes an essential job in managing and sharing cloud resources among diverse cloud users. Consequently, task scheduling is the primary research problem in the territory of cloud computing. In this survey paper, different task scheduling algorithms in cloud computing conditions dependent on discernable scheduling parameters have been analyzed. Different scheduling algorithms chips away at particular scheduling criteria, all algorithms are proficient somehow. There is an opportunity of proceeding and improving the recently finished work in this field. There are likewise a few constraints in each algorithm. Consequently, there is a requirement for a task scheduling algorithm for mapping tasks to resources to limit the makespan, execution time, and reaction time and increment the resource utilization rate.

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