Healthcare scenario: a new task scheduling algorithm in cloud computing environment

Nidhi Bansal[1], Ajay Kumar Singh[2]
[1]Department of Computer Science and Engineering, AKTU (Formerly Uttar Pradesh Technical University), Lucknow, India
[2]Department of Computer Science and Engineering, KIET Group of Institutions, Delhi-NCR, Ghaziabad, Affiliated with AKTU
(Formerly Uttar Pradesh Technical University), Lucknow, India

Article Info	ABSTRACT
	Makespan and cost are the major factors in the current scenario and they generally upgrade the results to optimize the upcoming task processing by implementing the scheduling within the specified cloud platform. A new proposed agenda is being considered for a health care system to make the world healthier. The paper is designed to identify prior work as a health evaluator for the end user and act accordingly. It also satisfies the end user by providing demanded results and can establish trust between the system and the customer within a global era. By analyzing the COVID-pandemic situation in the digital world, things should be implemented in conjunction with healthcare and technology to serve things better. The proposed algorithm works on priority basis by analyzing the current patient condition and then implemented in CloudSim Toolkit. As per the results, the proposed steps are performing 50-70% better in terms of makespan and cost. Notable optimization has been accomplished by the proposed healthcare evaluator.

Corresponding Author:

Nidhi Bansal
Department of Computer Science and Engineering, AKTU (Formerly Uttar Pradesh Technical University)
Lucknow, India
Email: nidhi18jul@gmail.com

1. INTRODUCTION

As growth of the world is depends on cloud computing technology, scientists are using this technology very frequently to get maximum attention towards research. Cloud computing is just a combo of things related to the developing articles, i.e., technology and software requirement specifications. By getting all stuff into a single technology is like a package for those who are beginners in this field. Beginners are the only future of the flourishment of the advanced world. Cloud computing is trying to acquire all roots, from where innovation can be transformed into technology. To spread the prodigious of the architecture of cloud computing, many small organizations are also using this technology by investing the precious amount. No doubt that cloud computing is escalating the popularization of their benefits [1]. Not only the technical field but to the nontechnical people shows the beautiful performance by getting the illiterate people educated. This is believed that popular things are beneficial but in reality other features are also important like reliability, quality, trust ability, and so on [2]. Apart from this, a selection for the best possible scheduling algorithm is becoming as a problem for run the coming real applications. Endless, this is the most important tag line for cloud computing that it plays an active role for every cheap as well as expensive service based on user insistences.

In the 1980s, cloud computing moved their steps towards IT firms for simple as well as complex calculations. In the expansion of cloud computing, the network created a different kind of cloud, and in the 1990s, the Internet connection system was launched to further develop [3]. People can do their work efficiently on the server of the cloud without any chargeable hardware device, due to this all things get become

independent. It provides a universal platform to all for doing their own tasks. Dependencies go disappear by using this renovate technology. Most of the organizations are using cloud computing as their front cover to get more attraction [4]. This service is like easy to carry for all developers, due to its feature, i.e. anytime-anywhere. Over time, in 2000, the usage of the cloud is increasing with the use of internet in high amount.

With the division of the cloud into different types, i.e., public, private, community, hybrid, more implementation works are in execution [5]. All clouds have their own characteristics and importance. For all types of categories, a developer has designed the facility according to their classification. By providing many varieties, organizations are using the combination of parts of the cloud. To solve the complex decisions, many rules can be created to get more accurate results. By using the amalgamation of these parts of clouds, more valuable results can be generated [6], [7]. The most important agenda is how to get the benefits of two or more types of designs at the same time. Now the hybrid cloud comes into the matter because it provides the most prominent fact by mixing the various models of cloud. The outer body of the hybrid cloud deals with personal or private feature, and then the information is passed to the intermediate public clouds. The merger of this technology keeps data safe from the outside world. The hybrid model reveals the procedure to keep the sensitive data secure and other important facts where organizations may get into a trouble condition by financial regimentation [8]. It is a very fruitful cloud technology for business purposive models. Every person working in a prestigious organization can have their own facts and can perform their individual implementation using this most advantageousness oriented feature [9]. The beneficial theme is that one can design their own set-up according to their own needs. Competition is also done in the various organizations, by calculating significant results day by day. The hybrid model makes the computing as a very easiest task by its exemplary attributes. A high-class enumeration is obtainable without worry about the expenses towards the innovation. Distribution, execution, computation, implementation, and all other required resources and services are very crucial for consideration in hybridization. Hybrid cloud recommends the expandability, low expense, dominancy, and safety attributes of public and private cloud, respectively. Correlation is very much important in hybrid clouds because principled development is not possible without a trust factor between the various types of cloud. To dominate others, some extra major facts should be kept in the process.

Clouds designed by Figure 1 need to dominate the other clouds for further development; the hybridization method has been made. Multiple conditions make a good mix for superior performance in all complex situations. Clouds of all kinds have been used to create a healthcare landscape as only essential content should be visible to the patient or user. Healthcare system refers to a process that involves complete material for the patient. When a patient clicks on the system with specified medical request the system responds immediately with healthy treatment through good prescription by consulting a doctor within a given time frame. The entire data will be operated through cloud servers only. And a cloud broker communicates in between. The broker is empowered to check the feasibility of the request by passing the content of the user/patient through the proposed scenario along with the proposed algorithm.
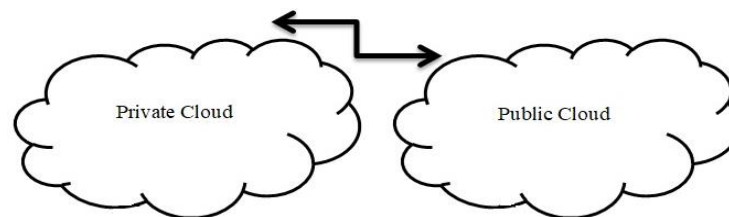

Figure 1. Hybrid cloud model

To get more attention from users, the dynamic environment is more useful to develop and test new files. By providing a pool of configurable resources, the availability of the resources has been increased for the users. It helps for the smooth running of application mobility within the experiments and fabrication. Without recording or replicating the data, relocation of the data from one system to another system is possible. Refocus of the used resources is also done to solve the complex obligations of a coming new real-life application. It keeps the worthy resources saved for better results of comprehensive computations. This reduces the inappropriate behaviour to gain more profit in the direction of experiments. With anticipation, it stops the blockage for a single deployment and more also. Since the remote sensing technique is very useful for doing any work, it is best to use in hybrid synchronization. By hosting the method on only one server, the administration of applications on any connected device can be possible anywhere. Effective data can be oppressed by any dislike and can collide with the whole system [10]. To prevent this torture, hybridization is

a very precious technique. Hybrid cloud method is the only way to create new recipes for the modern cloud and e-commerce expands with the consideration of new upcoming requirements. Hybridization also supports the situation when any cloud prevents any work from happening [11], [12]. Package gives the freedom to use different types of rules in the developing method, this type of cloud collaboration can lead to bargaining.

People will start the scanning process through their biometric accredited facilities. Hospital software will identify those who wish to enter the system to process the work. If the biometric system will indicate the signal as the correct value, then the software will allow people to begin its process for a particular task. After proceeding with this step, authentic people will start sending valuable data with its security flag. Using encryption will encrypt the data and process it securely. After implementing security factors in the data, it will move to the cloud system. Cloud computing is the best part of the work process accomplishment, which will create a data repository for the data set from the system hospital and mark it as an important task with some applicable secure tags [13]. Now the final step will progress towards the completion of the task by applying the best scheduling algorithm with load and task balancing on various multiple virtual machines. This last section requires hardware implications to compromise the work done successfully and then it gives a lot of beneficial and useful results for users.

2. PROPOSED ALGORITHM

Healthcare request is one of the emergence services which need an effective scheduling algorithm to meet the user requirements. It also accomplishes the solution by providing the fruitful scheduling algorithm. Figure 2 is showing the proposed scenario for execution of the new proposed algorithm. Healthcare requests are varied between data processing and decision making. Our algorithm manages the submitted tasks/requested on the cloud computing. The algorithm is divided into some stages:
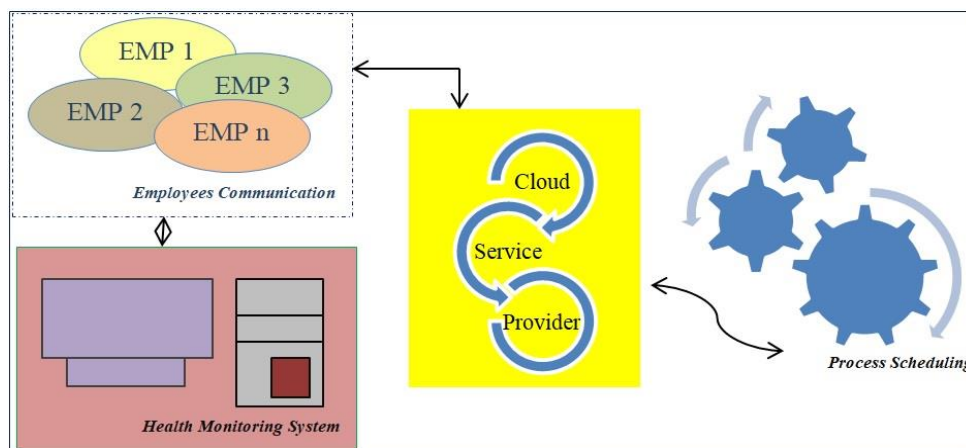

Figure 2. Proposed healthcare scenario

Stage 1: Data security; in proposed algorithm, block chain technology has been used. The security algorithm starts with check if the user is authorized or not. Once the algorithm assured from the user is existed in the system, it starts to save the submitted data into a new block with new hash. After that, the algorithm sends the requested to the scheduled.

Stage 2: Scheduling algorithm; firstly, the algorithm starts all requests according to the degree of importance. It divides all requests into emancipation, important, and rest. User can set the degree of importance according to his needs. The algorithm starts to assign virtual machines (VMs) to the emergence requests to execute all of them as soon as possible. The algorithm can search the fit virtual machine which meets the request needs to assign. After all emergence requests are assigned, the algorithm checks if there are free VMs to use them in executing the second group of important requests [14], [15]. If there are not free requests, the algorithm will add new free VMs to meet the important requests. It adds the number of free VMs equals to half number of important requests. Then the algorithm assigns two requests to one VM. The last step algorithm will wait for any free virtual machine to use it in executing one or more requests in the rest requests, where the free VMs send message to the scheduler that it is ready to execute new requests.

The scheduler sends the results one by one to the user after the VMs complete the execution. According to the budget of each hospital, the provider adds new free VMs to the user. The user can control his

budget according to the number of requests in each degree of emergency, where increasing the number of requests in the emergence list increase the budget of the user [16]-[18]. The last stage is the evaluating stage. In this paper, a new healthcare procurement system has been proposed with a new task scheduling algorithm, as shown in Table 1.

Table 1. Proposed algorithm: advanced identifier algorithm

```
Input: Tasks
Output: Scheduling Solutions
1-      Divides all requests into emergence requests and normal requests
2-      Order the normal requests according to the arrived time
3-      For each emergence request
4-      Assign each request to free VM to be executed
5-      End for
6-      For each normal request
7-      Assign the selected request into the VM which meets the requested requirements
(memory and number of cores)
8-      If there is no VM, which indeed
9-      Go to step 6
10-     End for
11-     If there are unassigned requests
12-     Order the requests according to its weight in UList //Unassigned List
13-     End if
14-     While there are unassigned requests
15-     Select a request from UList
16-     Assign the VM which meets request requirements to the request
17-     If there is no suitable VM, wait threshold time
18-     If a suitable free VM is available, assign it to the request
19-     Else go to step 14 to schedule the rest requests until suitable free VM exists
20-     End while.
```

3. METHOD

Cloud computing technology has become a role model that gives credibility and trust to the user through its services and methods. Even as COVID-19 becomes a situation that always needs to be taken into account, it means that no one can ignore this epidemic situation. Due to this, many of us are facing and fighting the disease, while some are staying at home and doing little in development of new techniques and social interaction. This can adversely affect the actual and internal health of the customer.

Phase 1: Coming Task→Assigned to available Virtual Machine→Meet the demanded requirements of the user→successful execution. **Phase 2:** Coming Task→Requested Virtual Machine is not free→wait for threshold time→Virtual Machine is now available→Meet the demanded requirements of the user→successful execution.

The proposed paper direction comes to make it financially secure for the customer/developer. The amalgamation of health and technology will give very fruitful results to the world in terms of technology for healthy people. Cloudsim toolkit takes the incoming requests in a queue and performs them on a priority basis which task should be done first, shown by the mentioned two phases [19]. In addition, the Cloudsim Toolkit is also held as an advantage for running this algorithm as it aids in many useful results. Some are described here [20], [21]. Minimum time to accommodate incoming request, huge structure to process request, easy implementation for big data, and open access to create and modify environment with variety of applications. Health issue is considered as a major concern in any circumstances, so keeping the worthy research; literature survey has been presented in the proposed paper and is shown in Table 2. Summary report is able to see things very clearly to diagnose the incoming material for indexed data which came from previous finished data.

Table 2. Findings from literure survey

Algorithms	Findings	Limitations	Tool used
Majorly health and technology-based algorithms	Mainly evaluate the makespan and cost	No cluster based used for scheduling	Cloudsim

4. RESULTS AND DISCUSSION

Under the simulation environment, three algorithms have been implemented and tested, namely, the newly proposed AA healthcare scheduling algorithm, round robin, and first come first serve [22], [23]. The result is that the proposed algorithm has yielded better results with some considered comparative parameters that are makespan and cost with different measurements. Figure 3 is showing the variation in makespan and

cost with differenet number of end users such as 10 users, 20 users, and 40 users. These are also depicting the improved performance for evaluating further research progress. Implementation is done through Netbeans IDE.

The states are separated by getting the value from makespan and cost, through different functions for different virtual machines. Makespan will sort through the completion time of the entire execution system. Cost factors include the cost per storage datacenter and the size of the viral machine. Here the total cost will be solved through the mentioned (1)-(3).

$$Total\ cost = Makespan + Cost \tag{1}$$

$$Makespan = effective\ time\ Tasks\ executed\ within\ the\ specified\ time \tag{2}$$

$$Cost = specified\ cost\ for\ server\ and\ the\ tasks \tag{3}$$

$$Virtual\ machine\ state = \begin{cases} successful \\ unsuccessful \end{cases} if\ effective\ time\ reach\ to\ the\ deadline\ |\ otherwise$$

By running Java code in CloudSim, an Excel file of cost factor is automatically saved to a specified drive of the system (user's specific). After the code is implemented on the machine, the code is run, and the execution time is shown in the Netbeans IDE output window [24], [25]. The number of users may vary with the number of incoming requests. Due to the performance of the device the system is stuck with the limited number of users that have been used to deliver the mentioned results. With high configuration device, user can increase the number of requests, the proposed algorithm will surely perform well for the same. Finally excel graph is designed by saved excel output sheet, generated through java code in cloudim software with netbeans editor.
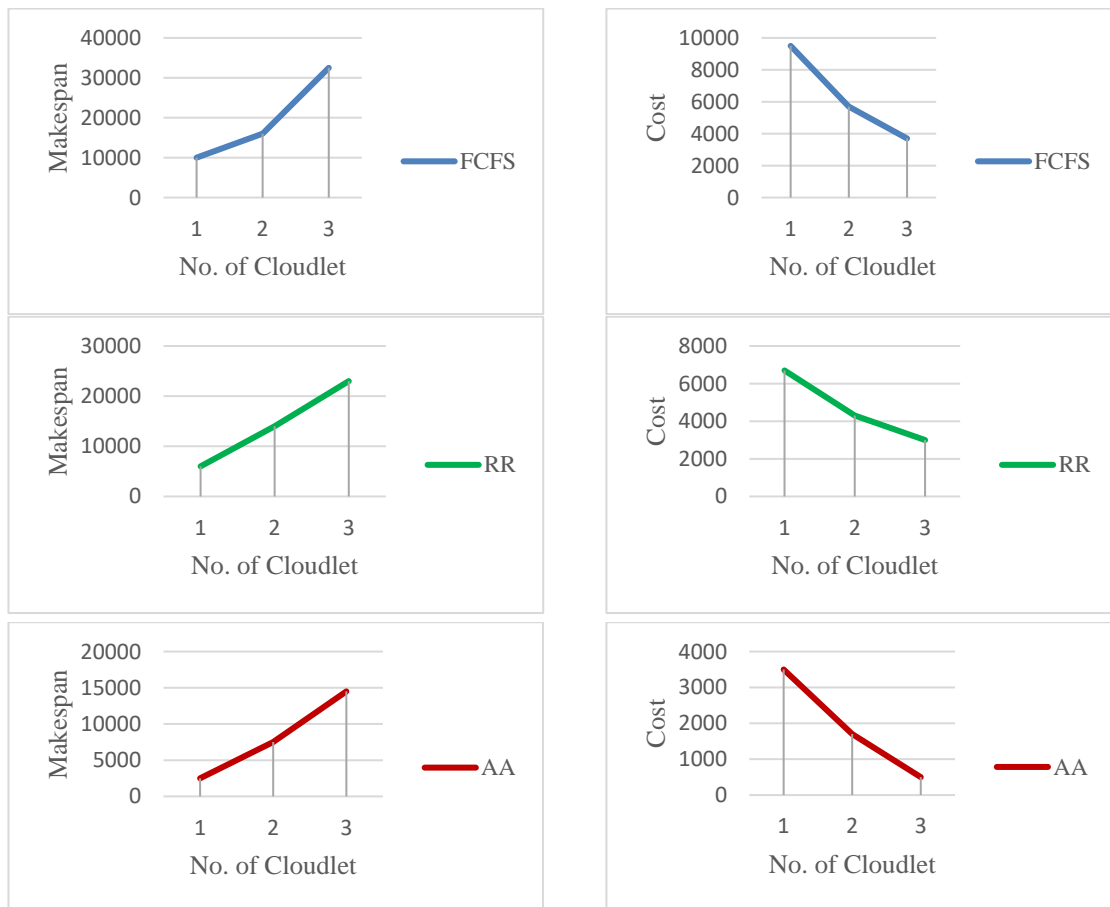

Figure 3. Makespan (ms) and cost ($)

Table 3 is specifying the improvement by letting percentage average value for the simulated real results. With round-robin and first-come-first-served, results increased by 50% and 70%, respectively. This implementation yielded remarkable results in terms of accuracy and reliability. The CloudSim toolkit has been used to achieve useful results to make the paper useful to all curious people of cloud technology. Also designed platforms or services meant to accomplish the goal in terms of technology enhancements are very useful in many ways.

Table 3. Performance measurements

Factors	Makespan measures in miliseconds		Cost measures in dollar	
Compared Algorithms	AA-RR	AA-FCFS	AA-RR	AA-FCFS
Improvement in percentage	50% average	70% average	50% average	69% average

5. CONCLUSION AND FUTURE WORK

In the wake of the pandemic situation, issues related to both health and technology, an idea clicked on the paper and tried to implement best choosing position by proposing a solution task scheduling algorithm for better health and quick treatment. Cloud technology came as a treatment for all vegan status and kept significant performance in it. Applications may include authenticity of the patient, proper analysis of the disease quick and accurate treatment. For further implementation, an intelligent planner should be implemented with some additional important parameters.

REFERENCES

[1] S. Tyagi, A. Agarwal, and P. Maheshwari, "A conceptual framework for IoT-based healthcare system using cloud computing," *6th International Conference - Cloud System and Big Data Engineering*, 2016, pp. 503-507, doi: 10.1109/CONFLUENCE.2016.7508172.
[2] P. Zhang, and M. Zhou, "Dynamic cloud task scheduling based on a two-stage strategy," *IEEE Transactions on Automation Science and Engineering*, vol. 15, no. 2, pp. 772-783, April 2018, doi: 10.1109/TASE.2017.2693688.
[3] S. R. Jadhao and S. Y. Amdani, "Performance related tradeoffs between fairness and throughput for job scheduling in cloud environment," *Procedia Computer Science*, vol. 152, pp. 122-129, 2019, doi: 10.1016/j.procs.2019.05.034.
[4] N. Bansal and M. Dutta, "Performance evaluation of task scheduling with priority and non-priority in cloud computing," 2014 *IEEE International Conference on Computational Intelligence and Computing Research,* 2014, pp. 1-4, doi: 10.1109/ICCIC.2014.7238289.
[5] S. K. Panda, S. S. Nanda, and S. K. Bhoi, "A pair-based task scheduling algorithm for cloud computing environment," *Journal of King Saud University - Computer and Information Sciences*, October 2018, doi: 10.1016/j.jksuci.2018.10.001.
[6] S. C. Nayak, S. Parida, C. Tripathy, and P. K. Pattnaik, "An enhanced deadline constraint based task scheduling mechanism for cloud environment," *Journal of King Saud University-Computer and Information Sciences*, October 2018, doi: 10.1016/j.jksuci.2018.10.009.
[7] K. Li, "Scheduling parallel tasks with energy and time constraints on multiple manycore processors in a cloud computing environment," *Future Generation Computer Systems*, vol. 82, pp. 591-605, May 2018, doi: 10.1016/j.future.2017.01.010.
[8] W. Tian *et al.,* "On minimizing total energy consumption in the scheduling of virtual machine reservations," *Journal of Network and Computer Applications*, vol. 113, pp. 64-74, July 2018, doi: 10.1016/j.jnca.2018.03.033.
[9] S. Srichandan, T. A. Kumar, and S. Bibhudatta, "Task scheduling for cloud computing using multi-objective hybrid bacteria foraging algorithm," *Future Computing and Informatics Journal*, vol. 3, no. 2, pp. 210-230, December 2018, doi: 10.1016/j.fcij.2018.03.004.
[10] S. Sebastio, G. Gnecco, and A. Bemporad, "Optimal distributed task scheduling in volunteer clouds," *Computers & Operations Research*, vol. 81, pp. 231-246, May 2017, doi: 10.1016/j.cor.2016.11.004.
[11] Y. J. Moon, H. Yu, J. M. Gil, and J. B. Lim, "A slave ants based ant colony optimization algorithm for task scheduling in cloud computing environments," *Human-centric Computing and Information Sciences*, vol. 7, no. 1, December 2017, doi: 10.1186/s13673-017-0109-2.
[12] R. K. Jena, "Energy efficient task scheduling in cloud environment," *Energy Procedia*, vol. 141, pp. 222-227, December 2017, doi: 10.1016/j.egypro.2017.11.096.
[13] M. Kumara and S. C. Sharma, "Dynamic load balancing algorithm for balancing the workload among virtual machine in cloud computing," *Procedia Computer Science*, vol. 115, pp. 322–329, August 2017, doi: 10.1016/j.procs.2017.09.141.
[14] W. Chen, G. Xie, R. Li, Y. Bai, C. Fan, and K. Li, "Efficient task scheduling for budget constrained parallel applications on heterogeneous cloud computing systems," *Future Generation Computer Systems*, vol. 74, no. C, September 2017, doi: 10.1016/j.future.2017.03.008.
[15] N. Bansal and A. K. Singh, "Trust for task scheduling in cloud computing unfolds it through fruit congenial," *Networking Communication and Data Knowledge Engineering, Lecture Notes on Data Engineering and Communications Technologies*, vol. 4, Springer, Singapore, 2018, doi: 10.1007/978-981-10-4600-14.
[16] P. K. Singh, M. Dutta, and N. Aggarwal, "A review of task scheduling based on meta-heuristics approach in cloud computing," *Knowl Inf Syst*, vol. 52, pp. 1–51, 2017, doi: 10.1007/s10115-017-1044-2.

[17]   M. Dutta, and N. Aggarwal, "Meta-heuristics based approach for workflow scheduling in cloud computing: A survey," *In: Dash S., Bhaskar M., Panigrahi B., Das S. (eds) Artificial Intelligence and Evolutionary Computations in Engineering Systems. Advances in Intelligent Systems and Computing*, vol. 394, 2016, doi: 10.1007/978-81-322-2656-7_121.

[18]   S. Singh and M. Dutta, "Critical path based scheduling algorithm for workflow applications in cloud computing," *International Conference on Advances in Computing, Communication, & Automation (ICACCA) (Spring),* pp. 1-6, 2016, doi: 10.1109/ICACCA.2016.7578905.

[19]   N. Bansal and A. K. Singh, "Effective task scheduling algorithm in cloud computing with quality of service alert bees and grey wolf optimization," *Indonesian Journal of Electrical Engineering and Computer Science,* vol. 25, no. 1, pp. 550-560, doi: 10.11591/ijeecs.v25.i1.pp550-560.

[20]   R. Kapur and M. Dutta, "Review of various load balancing and green computing techniques in cloud," Journal *of Basic and Applied Engineering Research*, Print ISSN: 2350-0077; Online ISSN: 2350-0255; vol. 2, no. 2; January-March, 2015.

[21]   N. Bansal, A. Awasthi, and S. Bansal, "Task scheduling algorithms with multiple factor in cloud computing environment," *Information Systems Design and Intelligent Applications. Advances in Intelligent Systems and Computing,* vol. 433. Springer, New Delhi. 2016, doi: 10.1007/978-81-322-2755-7_64.

[22]   M. B. Gawali and S. K. Shinde, "Task scheduling and resource allocation in cloud computing using a heuristic approach," *J Cloud Comp*, vol. 7, no. 4, 2018, doi: 10.1186/s13677-018-0105-8.

[23]   C. Cheng, J. Li, and Y. Wang, "An energy-saving task scheduling strategy based on vacation queuing theory in cloud computing," *Tsinghua Sci Technol*, vol. 20, no. 1, pp. 28–39, 2015.

[24]   N. Bansal and A. K. Singh, "Grey wolf optimized task scheduling algorithm in cloud computing," *In: Satapathy S., Bhateja V., Nguyen B., Nguyen N., Le DN. (eds) Frontiers in Intelligent Computing: Theory and Applications. Advances in Intelligent Systems and Computing*, vol. 1013, 2020, doi: 10.1007/978-981-32-9186-716.

[25]   N. Bansal and A. K. Singh, "Valuable survey on scheduling algorithms in the cloud with various publications," *Int J Syst Assur Eng Manag*, 2022, doi: 10.1007/s13198-022-01685-3.

BIOGRAPHIES OF AUTHORS

Nidhi Bansal 🆔 🔍 SC Ⓟ born in December 1990, Meerut city. She is pursuing PhD with CSE branch from AKTU Lucknow. She became an Assistant Professor in 2014 after M.E. from NITTTR Chandigarh. Her current research interests include Scheduling algorithms, IoT concepts, Machine Learning algoithms and its applications. She can be contacted at email: nidhi18jul@mail.com.

Dr. Ajay Kumar Singh 🆔 🔍 SC Ⓟ born in 1974 at Dhanbad (Jharkhand). He had done B.E (Computer Science and Engg.) from Kumaon Engineering College, M. Tech (I.T) Allahabad, Ph. D (Computer Science and Engg.) Jaypee University of Information Technology. Work Experience: He had been in different institution/university like RGEC Meerut (U.P), Sir PSU, Bhatewar, Udaipur, Rajasthan, JUIT, Waknaghat, Solan (H.P), MITS, Lakshmangarh, Sikar, Rajasthan, N.I.T Kurukshetra (Haryana), SSI Ltd. (Delhi) and MIET Meerut. Now he is working with KIET, Ghaziabad. He has published more than 70 papers in reputed Journals/Conferences and 5 patents. He can be contacted at email: ajay41274@gmail.com.