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User Request Scheduling for Multimedia Resource using Improved Fuzzy Logic with Hybrid Lyapunov Based Algorithm in Hybrid Cloud

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Abstract**: *The hybrid cloud provides vast opportunity to access the varied resources for effective provisioning of services to its users. The proposed scheduling algorithm uses the K-Nearest Neighbor(KNN) to locate the current location of the user and the nearest available computing resource. The Improved Fuzzy Logic (IFL) is applied for improving the resource balancing so that the resources are better utilized for the scheduling process. The wastage of resource usage and ideal resource are reduced considerably. The HLA scheduling is applied with the IFL, and based on the waiting of the jobs; the slots are allocated with jobs for execution. All the jobs are executed successfully with minimized execution time and makespan of the workflow application request. The performances of three algorithms are measured with parameters such as execution time, makespan time, in millisecond (ms). The execution speed is measured as throughput in MIPS (Millions of Instruction per Second). The resource utilization and usage of VMs are increased in the proposed scheduling algorithm resulting in a less number of ideal resources and reduced application cost.***

Index Terms**: *Improved Fuzzy Logic, Hybrid Lyapunov, Workload balancing.***

I. INTRODUCTION

The H-Cloud contains the combination of various cloud deployment models, the effectiveness of a good scheduling is based on the speed of execution, it also matters how well the needed resources are managed and balanced so as the execution is fast and also the distribution of resource and its access. The cloud computing has a very strong ideology of virtualization. The entire real life products and applications such as Google andFacebook etc. Use the concept of cloud computing with virtualization as its key logic of maintaining the underlying resources. The resources such as network resource, storage resource, computing resources, communication resources, platform resources and data resources are provisioned to the cloud user in two perspectives, the first is the real amount and details of the actual resource of the cloud resources is hidden from the Cloud user (any cloud user), but still the Cloud Service Provider (CSP) has to keep track of the actual resources and available resources of the cloud. The second perspective is, the management of the resources are virtually provisioned to the cloud user(any cloud user). The virtual amount of resource should be accurately managed and maintained, at the same time it should be available to the user at any given time. Virtualization is strongly applied in-between these two perspective of resource management. The H-Cloud user could experience the effectiveness and quality of its services from the H-cloud based on the access of those services. The service could be accessing certain data directly, applications, and it also can be selected infrastructure services. The H-cloud cloud user request for workflow application as a service request, which involves accessing for multimedia data or resources access could be completed using the proposed algorithm .The MK-SVM-HLA proposed algorithm performs an adaptive scheduling strategy involving effective usage of resource, so as the virtualization could be best applied so the virtual resources are effectively utilized. In this paper, the balancing of the resources is also considered, the balancing resources could increase the resource utilization and this in turn increases the overall execution and completion time of the service request for the workflow application from the H-Cloud user.

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II. LITERATURE REVIEW

Ant Colony Optimization (ACO) Algorithm:

Dorigo et al. (1996), Mohan et al. (2012) and Li et al. (2011) have proposed an Ant Colony Optimization algorithm. Because of the amazing behaviour of the ants,the ants are able to find shortest path to their food source and to their nest. Ants also communicate with other ants in the nest by pheromone trails. The trails are the dropping left on the tracks of the ants, depending on the concentration of the trails other ants where able to find the time and track them accordingly. Ants travel from nest in search of food and travel back to nest when they find the food and it follows random direction until it finds food. As it moves randomly it leaves pheromone trails. When an ant finds the food source, it has high concentration on its pheromone trails. The pheromone trails which is there for long time period, it tends to evaporate, so pheromone trails which was shed recent would be available for the ants to traverse to reach the food source using shortest distance.

This structure is called Ant Colony Algorithm (ACO).

Mishra et al. (2012),Hua et al. (2010) and Tawfeek et al. (2013) have explained the steps for functioning of the ant colony optimization algorithm. Li et al. (2011) have proposed novel ant colony algorithm to effectively schedule on cloud environment. The implementation of the algorithms to find the pheromone trails best suited for the shortest path, follow as

1. Initial values of pheromone are set values.
2. Initial population of the ants is generated and evaluated.
3. While termination condition is not met,

Do:

a. Update pheromone values and solution from each ant based on their concentration

b. Evaluate every ant.

4. The best solution found and returned.

Honeybee Foraging (HF) Algorithm

Karaboga et al. (2009),Baykasoğlu et al. (2007) and Hsieh et al. (2011) have come up with Artificial Bee Hive algorithm, which functions based on the nature of the true bees. The efficiency of the cloud computing environment is based on the implementation of load balancing and task scheduling, which eventually increases user satisfaction, Honeybee Forage (HF) technique used task allocation and resource balancing. When the tasks are allocated to the virtual machine (VM), the current load of the VM. When the VM become overload, the tasks are transferred to the other VMs which have the workload below threshold. This technique distributes the load on the fly, dynamically and ensures the performance of the cloud and avoids misbalancing of the resources (VMs) Ziarati et al. (2011) and Abou-Shaara et al. (2014) have observed artificial bee farming and describe the nature of the bees for solving complex problems. A colony of honey bees can extend itself over very long distances (over 14 km) and in multiple directions simultaneously to harvest nectar or pollen from multiple food sources (flower patches). A small part of the bee colony, keep searches for the new flower patches. These are called as scout bees, their work is to search for new environment and look for flower patches, and they also evaluate the honey collected and its quality. Once they return to the bee hive, they go the dance floor and do waggle dance through which the scout bees communicate the location and quantity of the honey .then new recruits of the foragers. Once the recruitment for foragers, the scout bees and forger bees fly again to the flower patches to collect the honey. Every time the return back to the hive, the scout bees evaluate the quantity and quality of the honey on the flower patch and do the waggle dance on the dance floor along with the forgers. It increases the recruits to the flower patch for the next fly to collect the honey.

Seeley et al. (2000) and Fang Y et al. (2010) have explained the types of bees and its functions. Bee system consists of two essential components:

- **Food Sources** the value of a food source depends on different parameters such as its proximity to the nest, richness of energy and ease of extracting this energy.
- **Foragers: Unemployed foragers**: the bees that do not have proper knowledge about the food source, location of the food source and quality. The bees that are initializes their search are unemployed foragers. They are two options to forage food, they are

i. **Scout Bee**: The scout bees start their search spontaneously by the knowledge they have gained inside nest. The number of scout bees in the nest and amount of information brought inside the nest various from 5 % to 30 % by the scout bees.

ii. **Recruit:** The bees start searching for food based on the knowledge gained at the dance floor by eagle dance. These bees follow as per information obtained.

- **Employed foragers:** Employed bees find the food locations found by recruit bees and exploit the food source. It also remembers the location of the food source so that food can be collect back to nectar several times. The same information is also shared in the bee hive.

Once the employed bees collect the food, it returns back to the hive for storing the food. When the flower patch have low amount food source, the employed bees abandon the flower patch and become unemployed bees. If there was high food source in the flower patch. It does any of the two procedure, it tell no other nest mates or it does the waggle dance and recruit more bees to collect the food source. The scout bees are selected and fitness values of the bees and related to the need resource are computed. The scout bees look out of the nectar and report the availability of the nectar. Based on the volume of eth nectar, the foragers' bees are assigned to the nectar to collect the honey (resource). If the resource is less no recruitment of bees will be done else foragers are recruited. The forager bees return to hive once they complete the resource collection.

III. PROPOSED PROPOSED IMPROVED FUZZY LOGIC WITH HYBRID LYAPUNOV BASED ALGORITHM (IFL-HLA)

Highlight a section that you want to designate with a certain style, and then select the appropriate name on the style menu. The style will adjust your fonts and line spacing. **Do not change the font sizes or line spacing to squeeze more text into a limited number of pages.** Use italics for emphasis; do not underline.

The proposed scheduling algorithm Improved Fuzzy Logic with Lyapunov based Algorithm (IFL-HLA) uses KNN methods to identify the nearest resource available for the user request. Based on the location of the user and location of the request resources the scheduling of the request is done by applying HLA. The scheduled jobs are executed.

IFL-HLA Algorithm

Input: Incoming H-Cloud user request for accessing multimedia resource

Output: Adaptive scheduling of the user request with improved fuzzy resource balancing for resource utilization

Step1. Incoming H-Cloud user request for multimedia resource.

Step 2. Incoming requests are classified based on the current location of the Step 3. Cloud user U_{CL} and the nearest available Cloud Service Provider (CSP) in the H-Cloud environment.

Step 4. After classification, the respective requests are directed to the mapped nearest CSP for getting processed.
Step 5. The requisition takes place by executing the request, HLA (Hybrid Lyapunov Algorithm) which is applied; the classified requests are split into jobs.
Step 6. The jobs are inserted to the available slots S1, S2…Sn.
Step 7. The HLA computes the waiting time of the jobs in Maximum wait, Minimum Wait and Null wait
Step 8. Actual waiting time of the individual jobs are computed in regular time intervals. $A_{act} = W_{max}$- Actual time of Job in the slot.
Step 9. If the Actual wait time > the $W_{max}$of the job,the job is pre-empted and allocated to another slot Sx which has less number of jobs to execute at the time t.
Step 10. The execution of the jobs is completed and the jobs are waiting for the actual resource to be obtained to communicate the response back to the user.
Step 11. Resource allocation and resource balancing is done using Improved Fuzzy Logic (IFL)
Step 12. The Fuzzy controller contains fuzzy learning, the availability of the resource is learned and rules of the fuzzy for accessing the resource are applied.
Step 13. Depending on the Workload (WL), Response Time (RT), availability of the resource is determined
Step 14. If WL && RT are high; addition of VMs to the resource is done.
Step 15. If the scaling factor is high; then the cost of resource access is high; then the next optimal resource is obtained by repeating steps 11 to 13.

Working Methodology of Proposed Algorithm:

The scheduling of multimedia request received from the cloud users are mostly from mobile handheld devices. The mobile devices are not stationary; their locations are dynamic in nature. The request raised by one mobile user may be at location n and the response received for the workflow application by the same user would be in anotherlocation. The same information may be sent to another user since the request and response travel among the users to complete cloud workflow application are in different locations.

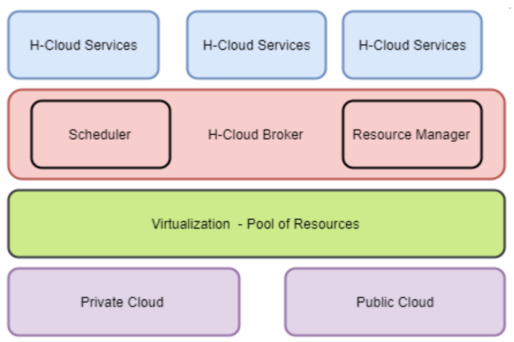

Fig 1.H-Cloud Architecture

Figure 1 shows the cloud architecture for proposed environment of the hybrid cloud. The H-Cloud broker contains the information and resources for executing 'n' number of user requests. The H-cloud user sendsthe requests which are centrally processed at the H-Cloud broker. In this chapter, the KNN is used to find the nearest CSP so it would be faster to execute the resource from cloud server side. The executed requests are communicated to the H-Cloud broker for accessing the actual resource, i.e. multimedia resources. The Resource Manager module contains the updated information of various available resource in the H-Cloud. The allocation of computing resource to process the user request is also allocated by analysing the nearest resource availability from the resource manager. H-Cloud also contains a scheduler module, which schedules the user requests and executes, and every CSP have their own cloud broker. H-Cloud Broker act as the Meta Broker (Head of Collective brokers of CSP in H-Cloud). It has the computing resources information and its location so that the nearest location to find the computing resource is done and allocated for effective processing of the H-cloud user request and decreases the execution time. The scheduler schedules the user request by applying IFL-HLA proposed scheduling algorithm, with information obtained from the H-Cloud broker, the resource information is obtained from resource manager from H-Cloud broker. The H-cloud services are provided to the H-Cloud user through the received requests, which are processed and scheduled by the H-Cloud broker.

K-Nearest Neighbor and Hybrid Lyapunov Algorithm (KNN & HLA) Based Scheduling:

The locations of the mobile devices are collected for a number of reasons such as locating resources and locating the service requested user. The received request for multimedia resources are classified based on the K-Nearest Neighbour algorithm, the request of similar services are classified as one.The Euclidean function is used for calculating distance measure between the received requests from the users. It is non-parametric method of classification.

Distance measure using the Euclidean function as shown in Equation 1 and 2 below

$$K = d(p,q) \quad (1)$$

$$d(p,q) = sqrt((p_1-q_1)^2 + (p_2-q_2)^2 \ldots\ldots(p_n - q_n)^2) \quad (2)$$

If K=1, single closest resource requested user to be selected.

K= number of requested users.

The distance measure is calculated for all given requested users, depending upon the value of K, the number of close range users are classified together. The value of p and q could be the selective value from the user's perspective; here p and q represent the distance and execution time. The execution time of the request is based on the location of the allocated computing resource, where it will be executed. Hence the KNN algorithm provides best effort in finding the location of the H-cloud user request and nearest location of a cloud service provider, where the request could be actually executed.Once the nearest and optimal location is identified, the H-cloud user request is sent to the cloud service provider (CSP). The classification of the user requests to the available computing resource is based on the location, the nearest CSP of the current location of the H-Cloud user could gather the request and execute faster.

It reduces the communication time and reduces the workload on the computing resources and evenly distributes the load among other CSP in the H-Cloud environment

Once the location of the CSP is identified, the request is sent to the CSP for further processing such as convert the H-cloud user requests into a sequence of jobs. The incoming requisition would be in the form request for any kind of workflow application. This workflow application would deserve multiple executions with various accesses to services and resources. The request is converted into jobs and further it is converted into tasks as per convenience. The jobs are scheduled based on the Hybrid Lyapunov Algorithm (HLA), which is based on the computation of waiting time of the job for its execution. The jobs are allocated in the slots and they are computed with the waiting time. Maximum waiting time of the job in the slot $W_{max\ and}$ minimum waiting time of the job in the slot W_{min} and the Null waiting time $W_{null.}$. When the waiting of any given job is zero or null, it can enter into the execution. The jobs are computed with their waiting time and based on which actual waiting time of each job is computed W_{act}as shown in Equation 5.3

Actual waiting time of Job J_x = (Maximum waiting time of job J_x) – (Actual time of job J_x) (3)

If the actual waiting time of the job is less the maximum waiting time, the job is continued to wait on the same slot and if the actual waiting time is greater than maximum wait time of job, the job is pre-empted and applied to another slot which has less number of jobs to be executed. When the waiting time of the job goes into long wait, based on the number of jobs in long wait additional number of VMs are increased so as the slots are created and jobs could be executed faster. When the wait time becomes null, the job enters the processor of the VM and gets executed successfully.

IV. EXPERIMENTAL SETUP

The experimental setup is the same as implemented in the earlier chapters. The H-cloud environment is created with H-cloud users and brokers. The key server provides user login verification and session key for the users. There source manager and broker will update the resource information from time to time. The scheduler implies the proposed scheduling algorithm IFL-HLA.

Hardware Configuration

The hardware configuration is unchanged .The experiment is conducted in simulated environment with 10 local host machines connected to one cloud server. The local host machines has the hardware configuration of Intel i3 processor with 4 GB of RAM. The cloud server is equipped with Intel Xeon E3 processor (3.40 GHz), 32 GB of RAM and 1 TB of local storage. The billing of the server could be hourly basis and monthly basis. The outbound bandwidth for the extended storage in server is also applicable and it is based on billing. The system should prepared with .NET frameworks and Java (JDK) package preinstalled.

V. RESULTS AND DISCUSSION

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In this section, the experiment results are discussed and analyzed. The performance of the proposed algorithm Improved Fuzzy Logic – Hybrid Lyapunov bases Algorithm(IFL-HLA) is compared with existing algorithms and proposed algorithm from chapter 4 MK-SVM-HLA is also compared . The algorithms that are considered for the result analysis are Ant Colony Optimization (ACO), Honeybee Foraging (HF) and MK-SVM-HLA. The experimental results are tabulated into various tables like makespan time, overall completion time, response time , resource utilization and application cost. The obtained results are graphically represented for better analysis of the performance.

Table 1. Comparison Table Based on Makespan – ACO, HF, MK-SVM-HLA, IFL-HL

Number of jobs	Makespan time ofACO (in ms)	Make span time of HF (in ms)	Make span Time of MK-SVM–HLA(in ms)	Makespan time of IFL-HLA (in ms)
50	92531	107710	89466	67822
100	118834	139801	119800	84381
150	147231	156772	138911	134221
200	174372	195447	179912	157721
300	243662	267750	248550	205620

The Table 1.Shows the makespan time of the existing and proposed scheduling algorithms. The IFL-HLA shows difference of 25.09 % compared with HF algorithm.

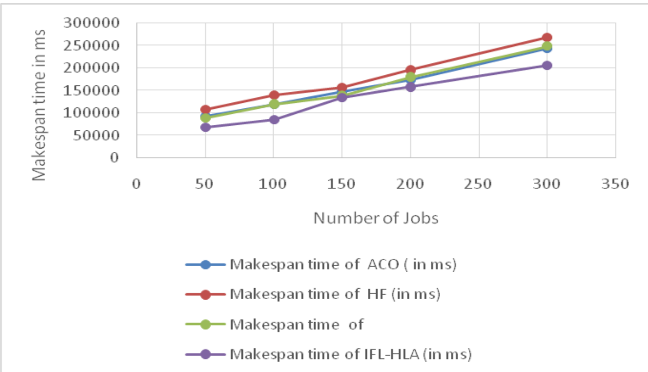

Fig 2 Makespan Time in Milliseconds– ACO, HF, MK-SVM-HLA, IFL-HLA

The Figure 2 shows the graphical representation of the makespan time in milliseconds (ms) of the scheduling algorithms. The makespan time of IFL-HLA with ACO and MK-SVM-HLA has improved difference of 16.3%,

which show the makespan has been decreased to 16.3%.

Table 2 Comparison Table Based on Overall Completion Time – ACO, HF, MK-SVM-HLA, IFL-HLA

Number of jobs	Overall Completion time of ACO(in ms)	Overall Completion time of HF (in ms)	Overall Completion time MK-SVM–HLA(in ms)	Overall Completion time of IFL-HLA (in ms)
50	249005	258250	273865	256711
100	297781	308266	316389	289901
150	344391	357388	364841	335611
200	418237	406711	429901	385600
300	528944	507002	535711	457391

The Table 2 shows the experimental results of overall completion time of the existing and proposed scheduling algorithms. The execution of the entire request processing is completed with the decrease of 6.1 % of overall completion time. The IFL-HLA algorithm shows 10.17 % improvement in overall completion when compared with MK-SVM-HLA scheduling algorithm.

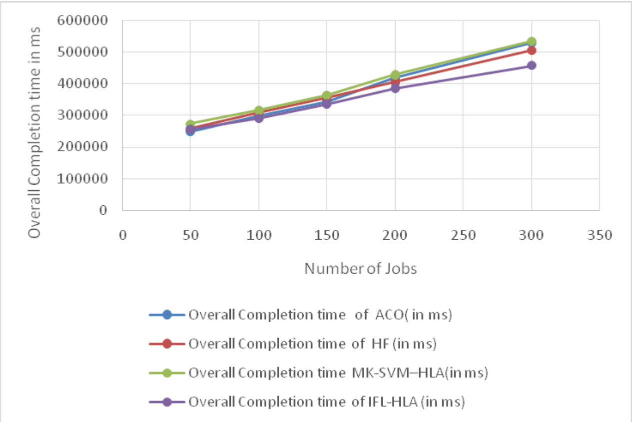

Fig 3. Overall Completion Time in Millisecond– ACO, HF, MK-SVM-HLA, IFL-HLA

The Figure 3shows the graphical representation of the overall completion time in millisecond among ACO, HF, MK-SVM-HLA, and IFL-HLA. The overall completion time of the proposed algorithm IFL-HLA has been improved 6.3% when compared with the existing algorithm ACO and HF.

VI. CONCLUSION

The efficiency of the scheduling process depends on few other parameters such as resource usage, load balancing etc. this chapter have proposed algorithms which considers scheduling with resource balancing to achieve improved scheduling resource utilization. The improved fuzzy logic provides efficient approach to choose optimal resource for successful and earlier completion of the requested service. The SLA monitor in order to reduce the application cost for the H-cloud users and to provide promised performance to the same users.

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