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Resource Allocation Assisted by Cloud Computing in Cyber-Physical System (CPS)

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***Abstract:** Resource allocation in general terms is defined as the allocation of data or information stored as resources depending upon the demand. This corresponds to the infrastructure or the virtual architecture of the system on demand. Resource allocation in profound databases is very monotonous and becomes a 'must consider' factor in order to avoid collateral harm to the present system. Cloud computing is a fusion network of sensors in remote locations to perpetuate different mode of functionalities like collecting, processing, integrating and storing data. This avoids the need for local server networks to perform the above-listed operations. Presently there are innumerable optimizing schemes and techniques depicted in the market specifically in relation to resource allocation in cloud data management. A lot of these algorithms or schemes has proved to be energy efficient and trouble free in the simulation environment. There has been a lot of research undergone to allocate resources and still, it exists as an emerging research platform. Thus the proposed scheme involves resource allocation assisted by the cloud computing techniques in a cyber-physical system. This is a unique hybrid between the cyber-physical system and cloud computing which can be optimal, scalable, and energy efficient at the same time. The simulation results succeeded to be far more efficient and faster than the existing proposals. The resource management speed and the time for execution are much better than the pre-existing systems as obtained from the simulation application and are charted out to show the deviations and irregularities in the current schemes.*

***Index Terms:** Cloud computing, Cyber-physical system, Resource allocation, Hybrid system.*

I. INTRODUCTION

Resource allocation or in general terms resource management is a predominant factor while considering a large fusion network. The technologies based on internet platforms have driven them to adopt distributed resource for computing in large scale sectors.

Cyber-physical system (CPS) and cloud computing are some exemplary examples of distributed resources when it comes to computing. This has a promising outcome towards the customer reach and mainly focuses on the emphasis on customer satisfaction. The CPS has humongous applications and few relatable downsides to different fields of expertise when it comes to a fused hybrid network. The main role of CPS would be to acquire the data using different designing tools and models as precursors. Then it processes them to next level of function with several integrating software and hardware in the network along with certain specifications which include detailing, variability, specificity to subsidize the data management issue. Presumably, it stores these processed data in a linear fashion based on the management scheme and the level of integration assisted in the system with regards to the serving models. A complete oriented CPS network, unlike traditional CPS network, consists of a huge number of communicating elements which includes both input and output figures. The main objective is to capture all the irregularities that currently exist in the field of cloud computing for resource management and address them with the proposed approach which can significantly improve its state of being and prolong the research platform into a different field of approaches. This system is hybridization between two distributed computing resources to address resource allocation issues in cloud data management. The simulation results succeeded to be far more efficient and faster than the existing proposals. The resource management speed and the time for execution are much better than the pre-existing systems as obtained from the simulation application and are charted out to show the deviations and irregularities in the current schemes.

II. LITERATURE SURVEY

We have researched our concept with many underlying existing approaches and finally brought out our own technological approach to the existing problem. The related works are listed here. In [1], they have engaged Virtual Machine (VM) technology for provisioning resources. It was expected that, by using VM technology, one can reduce the job response time on average and can also execute different performance tasks corresponding to the availability of resources. In [2], they have introduced a new concept termed 'skewness', which will aid in measuring the unevenness in resource utilization of the multidimensional server. Minimization of skewness can prevent workloads which are proved with several simulations driven on the experiment. In [3], they identified the most two resource allocation and allocation problems in cloud computing and addressed them along with a description to Hadoop-MapReduce and the schedulers associated with the scheme.

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They have also presented a survey of approaches differing in functionalities to solve problems relating to resource allocation. In [4], the paper is focused on the comparative and detailed study on the affirmative resource allocation strategies by protecting the service level agreement. This paper also provided a brief explanation of the algorithms used for allocating resources under multiple job situations with differing burst time and different resource requirement. In [5], they have addressed the problems associated with the assignment of tasks in heterogeneous cloud system which was then proved to be an NP-hard problem. They have projected an approach known and coined as 'Smart Cloud-based Optimizing Workload (SCOW) which is used to enumerate the cloud capability and assigns different tasks to the cloud which is heterogeneous in nature while considering sustainable factors.

In [6], the paper explored the application of two new optimization algorithms and furthermore hey proposed a hybrid algorithm in the intention to increase the throughput of the cloud provider's network. They have also evaluated the efficacy of the anticipated algorithm by comparing it with the TLBO and GW algorithms and presented the experimental results. In [7], they have provided a literature review on the proposed dynamic resource allocation techniques that have been introduced which will aid the way for research scholars. In [8], they have anticipated the different resource allocation strategies in addition to its applications towards cloud computing environment. Based on different resource allocation strategies available, they have addressed the foremost challenges faced in each technique. In [9], this paper is based on the literature review focused on the allocation of different resources which includes data, servers, and applications in the cloud computing technology. They have explained the resource allocation process in cloud data management and computing in depth. In [10], they presented a survey on both static and dynamic resource allocation techniques and provided a comparison study between the two states all possible challenges and problems. In [11], they provided a review of resource management and job scheduling in cloud computing. They have also addressed the popularity of cloud computing in recent times and discussed a few major challenges that the system faces in the environment. In [12], their main objective was to provide a reliable resource allocation technique to efficiently minimize the cost of it. They have provided different performance analyses to validate their approach and the simulation results showed increased reliability for their approach. In [13], they proposed an algorithm that stated the inner workings of the Resource Allocation System (RAS) in order to optimize the maintenance of resources. They have finalized the working of the algorithm and depicted the simulated results

III. CLOUD-BASED RESOURCE ALLOCATION TECHNIQUE

In the proposed system, the mapping of cloud computing performance is achieved by recording the execution process. Then the generated workload is varied which are obtained from the multimedia tasks and thereby the computing resource cost and the performance is not similar as well. When a workload component is executed in a cloud computing in multimedia service or task, it splits up the workload into a few smaller components in the system. Then these split up individual workloads will form a tree structure and they are executed individually.

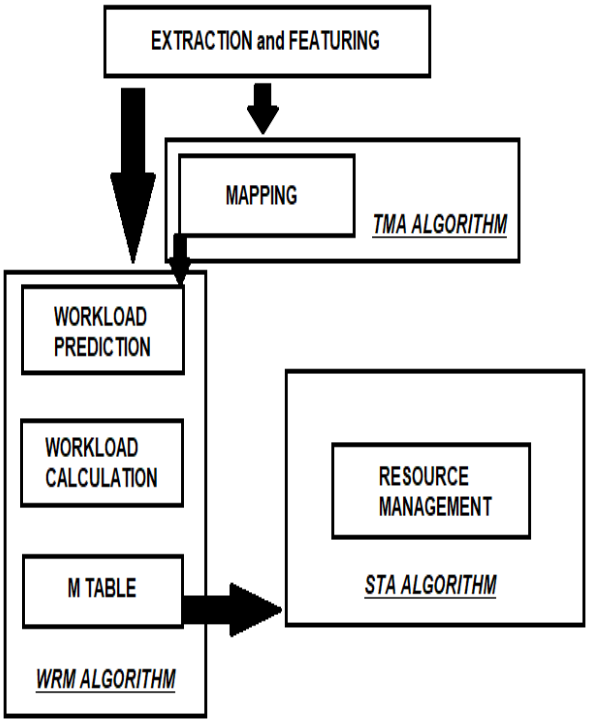

Fig. 1 System Path Architecture

They require their own separate computing resources and operate parallel in the network. This is a not uncommonly visualized in theoretical concepts in multimedia like Central Processing Unit (CPU), Graphics Processing Unit (GPU), and General-Purpose GPU (GPGPU). With this one can select different paths to choose performance and resource costs. Fig. 1 pictures the proposed scheme's inner working patterns in a flow chart. The foremost step that is added in a multimedia process is feature mapping and feature extraction. These so-called 'features' or simply minutia is the point of interests in a data or package.

These features are extracted to form a template. It's because one cannot send or receive the entire data wirelessly in a network. Thus templates are generated in order to avoid collision of data in the network. Then using the TMA algorithm, the features are then mapped accordingly. In the workload resource management algorithm, there are three components or functionalities such as workload mapping, workload calculation, and M table. SO the workload for each task is identified, calculated, and are recorded and segregated according to the M table. Then in resource management segment, the resources are separated according to the need using STA algorithm. The individual components in the system are detailed below.

Workload Management

In workload management, the dissimilar workloads are characterized by extracting the fundamental features from the tasks. The next step in the WRM algorithm is identifying the workload scaling from different datasets.

In order to store different datasets, a reference dataset is used as a reference in the process of workload scaling identification. The chief intention of workload Resource management algorithm is as follows,

$$f(n) = f(n-1) + \min n \{f(W1), \ldots f(W_i), \ldots ; f(W_m)\} \quad \ldots\ldots\ldots (1)$$

In (1), n Ɛ N; i Ɛ N and f (0) = 0. The **n** refers to the **n**th layer in the workload; W_i refers to the alternate workloads available in the process.

Extraction and Identification

The first step in the cloud computing process to allocate resource is extraction followed by identification before entering into the WRM algorithm. The extraction of features is done beforehand to avoid unwanted data collection and also to avoid the usage of resources. Once the features are extracted, they are they identified as workload scaling. This identification process is carried out because it determines the resource allocation criteria for each and every task in the multimedia network. This will render in the preservation of resources to multiple tasks forthcoming.

Workload Mapping

The next step in the process is workload mapping or workload pre-mapping. This mapping is done to predict and tabulate cloud service capabilities. This mapping is done by evaluating the predecessor performances. So this acts as a predicated forecast for resource allocation for cloud tasks within the network. There are three unlike variation selection techniques, which include Cumulative Moving Average (CMA), Moving Average (MA), and Weighted Moving Average (WMA). The Moving average is premeditated for non-emergency purposes. The consecutive collective averages are deliberated with the help of the Cumulative Moving Average practice. The WMA is simply used to gather the probability of the victory of each task.

WRM, STA, and TMA combinations

The workload resource management algorithm's main accomplishment is to create M table for assigning the resources to each individual task in the subset process.

The STA algorithm will minister to designing an optimal resolution for the assigning parallel task to compound cloud servers. The TMA will supply the capacity and availability of information about the cloud servers.

M Table Generation

The M table is the forerunner to the resource management process in the computing association. First, the task is divided into subtask within the network according to the priority of execution of the individual task. Then they are arranged according to in a linear fashion to perform subsequently without any interruptions. The arrangement is done using the priority given to the subtasks according to the need. This M table generation is done using the WRM algorithm as an end result of it would become the table.

Hybrid system

Hybrid systems are an amalgamation between two or more assorted systems that work and fuse together to structure a single system. Hybrid systems are always much more efficient than the present system. Hybridization includes fusion of both the functionalities and the components of both the systems in use.

IV. RESULT EVALUATION AND VALIDATION

The result of resource allocation assisted by cloud computing in the cyber-physical system is simulated and discussed below. The results are charted out in comparison to the currently existing system. Fig.2 charts out the workload predicted in the system in retrospect to the resource allocated in comparison to different levels of subtasks carried out in the network. From the graph, it is seen that at the onset, the workload seem to be increasing but towards the end along the process, it gradually decreased.

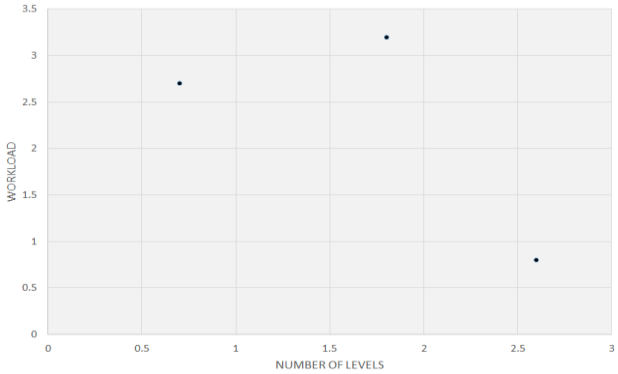

Fig.2 Workload Prediction

The inference is as the number of levels increases the workload seems to decrease hereby one can reduce the resource needed to perform the task. The chart is scaled 0.5 units each in both the horizontal and vertical axis. Fig. 3 represents the execution time required by the network in comparison to the pre-existing systems. The parallel axis denotes the time in single units and the upright axis denotes the systems in comparison both the proposed system and the on-hand system. The color comparison shows us that the currently proposed system has very low execution time almost half the time needed by the existing system. Fig.4 denotes the resource management speed required by the system.

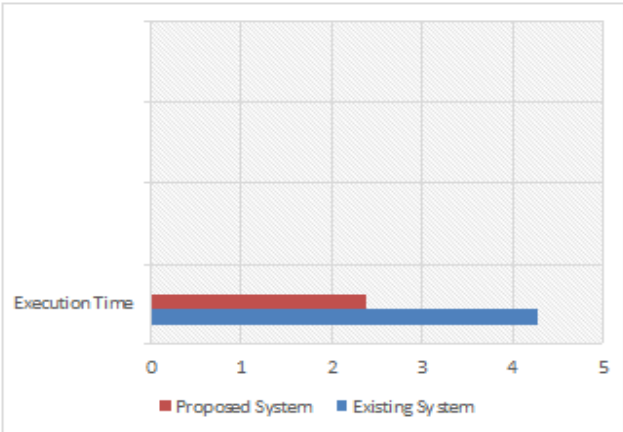

Fig. 3 Comparison of Execution Time

It is also a comparative chart run during the simulation of both the proposed system and the existing system. The chart compares both the system at four different levels of execution of the task. The erect axis denotes the resource management speed of each task and the level axis denotes the different levels of task.

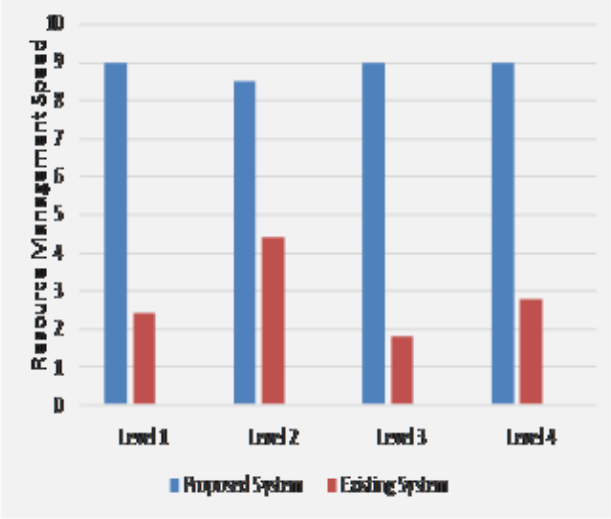

Fig. 4 Resource Management Speed

V. CONCLUSION

Thus with the proposed approach, we have successfully managed resource allocation in the cyber-physical system using cloud computing. This was achieved with the help of hybridization of two computing systems in cloud data management. The simulation results showed significant improvement in the proposed system than the currently existing system. This approach can solve some preliminary challenges faced in the resource management sector in cloud computing. This system is also flexible to further modifications and additions depending upon the needs presented by the user and are user-friendly. This system is also cost-effective in case of resource management and the programming or algorithm is simple enough to execute. This modal proved to be sustainable and can solve preliminary issues posed by the cloud computing environment.

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