Parallel Clustered Particle Swarm Optimization in Mobile Environment

Ms. Preethi Sheba Hepsiba¹, Ms. Suma O N P²
Assistant Professor, Dept of CSE, MVJCE, Bangalore
M.Tech Student, Dept of CSE, MVJCE, Bangalore

Abstract-The proliferation of mobile computing, and smart phone technologies with their sensing service have resulted in an increasing number of services from a myriad of service providers. These mobile service providers support numerous ranges of emerging services with various quality metrics but similar functionality. To facilitate an automated service workflow, it is required to select and combine several services from the services pool in the fastest way. Mobile environment is ambient and dynamic in nature that requires more efficient techniques to deliver the required service composition promptly to the users. It is a challenge to select the optimum required services in minimum time from the numerous sets of services with dynamic qualities. This challenge is addressed in this work as an optimization problem. An algorithm is developed by combining particle swarm optimization and k-means clustering. It runs in parallel using MapReduce in Hadoop platform. By utilizing parallel processing, the optimum service composition is obtained in significantly less time, which is essential for handling massive amount of heterogeneous data and services from various sources in mobile environment. The suitability of this proposed approach for big-data driven service composition is validated through modeling and simulation.

Keywords: Big Data, clustered particle swarm optimization, service composition, mobile environment, big data management.

I. INTRODUCTION

Today, there is a growing number of mobile or smart devices as well as smart sensors providing a myriad of services that range from social media, healthcare to smart home. This trend is further observed by an ever-increasing number of personalized, financial and consumer related mobile apps and services (e.g., social media, entertainment to healthcare) to improve safety, comfort and quality of our daily lives. In order to satisfy user demands, suitable candidate services need to be selected from a vast number of value-added services in the mobile environment. These services and applications generate a massive amount of structured (e.g., data from the traditional database), semi-structured (e.g., email, social media feed. Sensor-related data feeds, web feeds) and unstructured (e.g., audio, video, image, and text) data from heterogeneous multi-sources in real time.

Mobile environment is dynamic and rapidly changing in nature. Huge number of services is provided by various service providers with different quality of service (QoS) attributes such as availability, reliability, computation time and so forth. In mobile environment, values of these QoS parameters change frequently. As during the service composition process, a huge amount of data and services are required to be handled, computation time is an important attribute to be considered to fulfill user’s tasks. It might be noted that a standalone service may not be able to fulfill a user’s requirements; therefore, a composition of services is required.
This problem can be resolved by forming optimal composition from possible available and reliable candidate services from the service pool to fulfill the user’s requirements. This scenario enforces the requirement of efficient optimization technique, which should deliver its output (i.e., optimized configuration) promptly to the user.

Hence the introduction of the parallel clustered particle swarm optimization (PCPSO) algorithm for service composition process (SCP). PCPSO is a parallel programming implementation of PSO. There is huge number of candidate services in the pool in the mobile big data platform, and this huge pool of services require much time to optimize. Therefore the optimization technique used is parallel in nature so that it reduces the computational time.

II. REVIEW OF LITERATURE

1. Ling Liu, et al [1] proposed a paper on big data analytics. The author says that the parallelism of data is promoted in many levels some of the things that can be defined about data and the task parallelism is summarized below.

**The parallelism can be:**
- data parallelism
- task parallelism

Data parallelism refers to simultaneous execution of same function across element of dataset
- Task parallelism refers to simultaneous execution of many different functions across same or different data sets
- Architectural innovation, software innovation and algorithm innovation for promoting data and task parallelism in big data is done by Vertical and horizontal computational parallelism.

Disadvantages:
Ensuring the load balancing. i.e. harder to devise good load balanced scheme for assigning partition to machine

2. H. Fang, Z. Zhang, C. J. Wang, M. Daneshmand, C. Wang, and H. Wang [2] et al proposed a paper on survey of the big data analytics and how the privacy concern are raised. Sharing large amount of information raises important security and privacy concerns. A hybrid approach is proposed where privacy requirements are captured in access control system and present a framework for composition and enforcement of privacy policy. A prototype named iPm (intelligent private manager) has been implemented.

3. M. R. Rahimi, N. Venkatasubramanian and A. V. Vasilakos [6] et al, proposed a paper on "MuSIC: Mobility-Aware Optimal Service Allocation in Mobile Cloud Computing. Using multiple levels can increase the performance scalability of the mobile applications. To model the mobile application a framework is proposed. LTW (Location time workflows)
Disadvantage:
Qos factors like price, power and delay
To over come the draw back MUSIC algorithm is proposed.
(Mobility Aware Service Allocation on Cloud)

- In recent years many research efforts have been made for optimization of service composition algorithms. Nqos is for service composition using geo-location.
• The main aim of this paper is to maximize the global QoS of Composite service with local and global QoS constraints while selecting independent candidate services from different service providers.
• The future enhancement would be predicting the network delays at different periods of service composition.

5. **T. Zhang et al [8]**, proposed a paper on QoS-aware Web Service Selection based on Particle Swarm Optimization. The summary of the paper is given below
• Fast QoS web service allocation approach is proposed
• This adopts the POS (Particle Swarm Optimization) algorithm
• Advantage:
  - This approach can satisfy the real-time requirement for the fast selection of web services
• Disadvantage:
  - There is no clear cut guidelines on what should be the best choice to some parameters of PSO.

### III. IMPLEMENTATION

The two-phase approach is used to find out the optimum set of services. These services include a set of related mobile services such as computation, big data storage, and other capabilities similar to media service (e.g., social and entertainment), messaging service and payment service that are provided by different cloud service providers, including local and public cloud.

In the first phase of the two-phase approach, some relevant services are selected using the PCPSO algorithm; and in the second phase, the optimum composition is obtained through applying PSO algorithm. These two phases are the primary selection and the final selection. These two phases can be summarized as follows:

**Primary selection:** In this phase, several groups of potential services are selected from the services pool, through applying parallel clustered PSO (PCPSO). Each selected group represents a task in the sequential workflow model for services composition process.

**Final selection for optimum composition:**
From each group of the first phase’s output, a single service is selected in this second phase by applying PSO. No parallel processing is utilized here. The output from this phase is the optimum (final) composition.

The service selection process is conducted using work-flow model based on QoS. In the workflow model, a workflow comprises of several tasks. To fulfill each task, a service should be selected from a number of candidate services in the services pool. The selection process of services for each task is conducted based on QoS parameters, which are used to calculate fitness function. This function facilitates evaluating optimum service composition.

Mobile environment is ambient and ever changing in nature. For this reason, values of QoS parameters for mobile services might change very quickly. To adapt with the ever-changing mobile environment, parallel processing is required in the service composition algorithm.
block diagram of the algorithm. This block diagram shows the two phases. At first, the primary selection is done through PCPSO algorithm. The output of this phase is the optimum set of service clusters (i.e., optimum clusters). Finally, the optimum solution is obtained from the optimum clusters through PSO algorithm.

**Sequential Workflow:**
The service composition process, the sequential service workflow model is implemented. A service workflow represents a complete process, which is a composition of services to complete a full work. Thus a sequential workflow is a sequential combination of several tasks. For each of these tasks, a single service must be selected from the services pool. The services are selected and composed based on QoS. Several of these models are sequence, switch or loop. For the sake of simplicity, only the sequence type is considered. It is described in Fig. 1(b). Suppose a workflow or composite service is defined as follow
wf1 = (task1, task2, …, taskm)

Each task can be conducted by using any one of the several services. For example, task2 has nine candidate services. These are S2,1, S2,2, …, S2,9. Here, total services, ts = 9. Any one of these nine services can be used to conduct task2. It is required to find out the optimum service from these nine services to conduct task2. This optimum service is specified as S2,op2. After executing the complete optimization programs, for example, we may find that, the third service is the optimum one for task2. Thus for op2 = 3, the optimum service is S2,3. After selecting all the optimum services for all the m tasks, the service workflow becomes as follows:

\[
wf1 = (S1,op1, S2,op2, …, S2,opm)
\]

Fitness Evaluation

The QoS parameters are used to select several clusters of services. The QoS parameters are: reliability, availability, reputation, computation time and computation cost.

To obtain the services composition for the workflow consider workflow wf1 using PSO, the composite values of the Qos are calculated for each of the five parameters i.e. reliability (Qreli), availability (Qavail), reputation (Qrepu), computation time (Qtime) and computation cost (Qcost).

Availability of wf1 is the product of each single service’s availability:

\[
Qavail(wf1) = Qavail(S1,op1) \times Qavail(S2,op2) \times \ldots \times Qavail(Sm,opm)
\]

Reliability of wf1 is the product of each single service’s reliability:

\[
Qreli(wf1) = Qreli(S1,op1) \times Qreli(S2,op2) \times \ldots \times Qreli(Sm,opm)
\]

Reputation of wf1 is the average of each single service’s reputation:

\[
Qrepu(wf1) = \frac{1}{m} \left\{ Qrepu(S1,op1) + Qrepu(S2,op2) + \ldots + Qrepu(Sm,opm) \right\}
\]

Computation time of wf1 is the average of each single service’s computation duration:

\[
Qtime(wf1) = \frac{1}{m} \left\{ Qtime(S1,op1) + Qtime(S2,op2) + \ldots + Qtime(Sm,opm) \right\}
\]

Service cost of wf1 is the average of each single service’s service cost:

\[
Qcost(wf1) = \frac{1}{m} \left\{ Qcost(S1,op1) + Qcost(S2,op2) + \ldots + Qcost(Sm,opm) \right\}
\]

Few of the values may be negative but i.e. the one with higher value has the low quality. This quality holds good for Computational time and the cost. The experiments shows that the major factors effect on all the other QoS Parameters:

If Q avail increases, then overall quality increases and fitness value should decrease.

If Q time increases, then overall quality decreases and fitness value should increase.
ACKNOWLEDGEMENT
It is my privilege to acknowledge with deep sense of gratitude towards project guide, Ms. Preethi Sheba Hepsiba, for her valuable suggestions and guidance throughout course of study and timely help in completion of the preliminary project work on “Particle Swarm Optimization in mobile environment”. I would also like to thank project coordinator Prof, Usha Ruby, and all other faculty members of Computer Science and Engineering department who directly or indirectly kept the enthusiasm and momentum required to keep the work done. I hereby extend my thanks to all concerned person who co-operated with me in this regard.

REFERENCES