Evolutionary algorithm MCSE

**Short Notes on the article titled-**

Service Composition in IoT using Genetic

algorithm and Particle swarm optimization

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# Assignment 07 from Lecture 08 (Sep 24, 2022)

# A. Write short notes about Problem, Background, Method, Experimental Setting, Experimental Result and Conclusion on your selected Article

# B. Submit PDF of the Article (File Name: Roll - Year – Title)

# Submission Deadline: September 30, 2022 9:00PM

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**Abstract:** Web service compositions are commendable in structuring innovative applications for different Internet-based business solutions. The existing services can be reused by other applications via the web. Due to the availability of services that can serve similar functionality, suitable Service Composition (SC) is required. There is a set of candidates for each service in SC from which a suitable candidate service is picked based on certain criteria.

Quality of service (QoS) is one of the criteria to select the appropriate service. A standout amongst the most important functionality presented by services in the Internet of Things (IoT) based system is the dynamic composability.

In this paper, two of the metaheuristic algorithms namely Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) are utilized to tackle QoS-based service composition issues. QoS has turned into a critical issue in the management of web services because of the immense number of services that furnish similar functionality yet with various

characteristics. Quality of service in service composition comprises of different non-functional factors, for example, service cost, execution time, availability, throughput, and reliability. Choosing appropriate SC for IoT-based applications in order to optimize the QoS parameters with the fulfillment of users’ necessities has turned into a critical issue

that is addressed in this paper. To obtain results via simulation, the PSO algorithm is used to solve the SC problem in IoT. This is further assessed and contrasted with GA. Experimental results demonstrate that GA can enhance the proficiency of solutions for SC problems in IoT. It can also help in identifying the optimal solution and also shows preferable outcomes over PSO.

# Introduction

The term IoT connotes the interconnected devices which allude to an accumulation of different physical gadgets around the globe that are presently associated with the web to gather and share information. The blend of information is retrieved through different sources. IoT is an accumulation of systems and gadgets that can speak with one another. It is perceived as a standout amongst the most imperative territories of future innovation and has got wide consideration from various applications. The peculiarity of the IoT isn’t in any new risky development [1, 2]. It is seen as the most important area among the most basic domains of future development and is expanding hugely from a broad assortment of endeavors [3].

Many devices like cameras, television, and refrigerators could be connected to the world via the Internet. The devices become part of the IoT by providing some information that can further be utilized by some applications.

These devices can be uniquely identified with the help of RFID tags. For example, an IoT-based application that is part of the Smart Home can keep track of the devices which are switched on and their power consumption at a particular time. Few IoT devices offer same service with

completely different quality parameters like high reliability, low response time and low cost [4]. These days cloud foundations give a section point to revelation, determination, combination, and devouring for such appropriate IoT services. Thus, another sort of middleware administration ought to be conceived by a cloud to choose and create the desired services dependent on the end client's requirements.

In the current literature of optimization in engineering applications, the nature-inspired algorithms have shown promising performance and thus these are popularly and widely used to solve various problems. The contributions of the paper are briefly described as follows:

1. GA and PSO are applied to solve the service composition problem in IoT. These meta-heuristic search algorithms are used to optimize the service composition multi-objective problem into a single objective problem by applying equal weights to all three QoS parameters.

2. The implemented algorithms are compared using the fitness value and time. Fitness value plays a key role in comparing their performance.

3. The effectiveness of implemented algorithms has been illustrated using a service composition application scenario in IoT environments with the real-world application data set.

The purpose of this paper is to compare the two most popular metaheuristic search algorithms GA and PSO for single-objective optimization to solve multi-objective problem of service composition in IoT using QoS parameters such as execution time, service cost, and reliability. The rest of the paper is organized as follows: Section 2 presents the concept of the Internet of Things along with its architecture and various applications in the literature. Section 3 then outlines the related work. Then in section 4, service composition optimization problem has been described. Section 5 includes the description of implemented algorithms: GA and PSO, Section 6 includes evaluation methodology which comprises of data sets, experimental settings, and solution encoding. Finally, the Results and analysis are drawn in Section 7 along with the empirical evaluation of the implemented algorithms on the real-world application data set in Section 8.

and the culmination of services with limited use. The objective

of SC is to locate an arrangement of services (one for every

task) that adds to the composite service and addresses

the user’s request. There are no specific means of defining

the SC that must fulfill the requirements of the user. There

are various QoS attributes that are used to characterize the

web services. Three main types of QoS parameters such as

execution time(t), service cost(c) and reliability(r) are considered

[19].

• Execution time (t): It is the time utilized by an IoT

service to respond.

• Service cost (c): It is the cost associated with an IoT

service.

• Reliability (r): It is defined as the degree of failure of

an IoT service.

In light of this, the SC problem is depicted as below:

For a given a set of ‘n’ tasks, the task is defined as the

service which is required to fulfill the user requirement,

G = {g1, g2, g3 . . . , gn}

Each task has ‘k’ no. of candidate services which provide

similar functionality,

gi={s1i , s2i,...,ski), ∀i∈[1,2,...n]

Where ‘i’ defines the class of a group with similar services

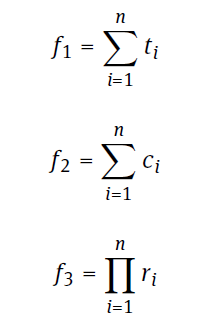
in accordance to their task gi.

The composite service C represents a group of tasks

C = {sa1, sb2 , . . . sk3, ∀a, b, c ∈ [1 . . . k]

The objective functions for execution time, service cost

and reliability are defined as follows:



Where ti is the time of the ith instance of a task. ci is the

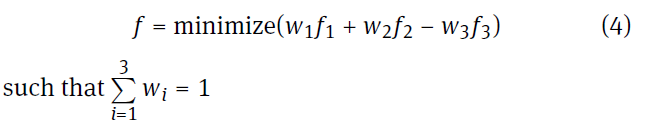
cost of an ith instance of a task. ri is the reliability of the

ith instance of a task. By giving equal weight to each QoS

property described in equation no. (1), (2) and (3) as three

objective functions respectively can be merged into a single

objective function as follows in equation no. (4).



***Conclusions and future work***

The role of optimization algorithms using empirical evaluation

of GA and PSO is shown to solve the problem of service

composition in IoT. The problem is to minimize service

cost, execution time, and reliability and select candidates to

execute each task in the service configuration. The experiment

is executed for a step size of 10 with the number of

tasks ranging from 10 to 30, and the number of candidates

for each assignment is also in the range of 10 to 50 with

the same step size. The results of the experiments obtained

with the algorithms generate 15 test data instances. Also,

statistically significant results are obtained with 95% confidence

level. The results obtained after the empirical evaluation

of the implemented algorithms on the real-world application

data set revealed that the solutions obtained usingGAare

more eloquent than that of PSO.As part of future

research,we will try to hybridize the genetic approach with

other metaheuristic search methods. It shall be also applied

to the datasets fromvarious other applications based

on IoT