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Hybrid heuristic algorithm for cost-efficient QoS aware task scheduling in fog–cloud environment

Syed Mujtiba Hussain [a,b,*], Gh Rasool Begh [a]

[a] Advanced Communication Lab, Department of Electronics and Communication Engineering, National Institute of Technology Srinagar, India
[b] Department of Computer Science and Engineering, Islamic University of Science and Technology, Kashmir, India

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ABSTRACT

Fog cloud computing promotes the combination of fog and cloud nodes to satisfy the requests of data accessing from IoT (Internet of Things) devices. To reduce the data delay and enhancing the QoS (Quality of Service), effective task scheduling is one of the major requirements in fog cloud environment. Numerous approaches have been deployed by the researchers for maintaining the QoS requirements. However, the emergence of bursty traffic affects the process of task scheduling due to high service latency. Effective QoS is promoted by minimizing the costs of computation, communication and deadline violation cost. To achieve the main objective of cost minimization, the proposed work is implemented by adopting a novel model called HFSGA (Hybrid Flamingo Search with a Genetic Algorithm) for better task scheduling. Seven basic benchmark optimization test functions are used to compare the performance of HFSGA with other well-known algorithms. Also, Friedman Rank Test is performed to demonstrate the significance of the results. The implemented model presents better outcomes with respect to PDST (Percentage of deadline satisfied task), makespan and cost. When compared to the existing algorithms that include Ant colony optimization (ACO), Particle swarm optimization (PSO), Genetic Algorithm (GA), Min-CCV, Min-V and Round Robin (RR) approach, the proposed work shows better output in satisfying the task scheduling process.

1. Introduction

In data processing and business applications, cloud computing is a promising model in implementing internet of things (IoT) [1,2]. In some cases like health care application that monitor the condition of patient, delayed responses may affect the human life. This becomes more severe when massive data is generated by IoT devices [3]. For example, smart city applications generate approximately one million records per second. When huge number of sensors are utilized in numerous applications with less accuracy, the chances of duplicating and error-prone data in IoT environment is high [4]. Hence the faulty and error-prone information might maximize the size of unwanted data. Exchanging enormous amount of data and request over the cloud might cause less utilization of network resource, long transmission latency, high cost, and processing overhead and large network traffic [5]. The cloud is made up of a collection of large data centers located in various geographical regions.

The cloud provides various kinds of services based on the user demand. The cloud can be able to find the other nodes by exchanging information for interoperability [6]. The cloud storage is a modern computer data storing system that reduces the expense of external hard drives resulting in low power consumption better efficiency in data storage at the costs of allocated space in cloud storage [7,8]. However, the Cloud computing paradigm is least applicable to sensitive applications due to its high latency and difficulties in real-time interaction. Hence, fog computing has emerged to enable applications such as smart transportation, health care and industrial IoT to perform application processing close to the user by leveraging constant processing power of heterogeneous end and edge devices [9,10].

Fog computing nodes acts as a bridge between the sensors and cloud layers capable of processing, networking and storage [11]. The fog computation is a type of edge computing, which is located between sensing IoT device and cloud storage unit [12]. The compensational rate is provided between clouds to the IoT devices. The fog acts as an intermediate unit which promotes local decision making instead of sending to the cloud [13]. The structure of fog computing consists of three layers such as IoT devices, fog node(s) and the cloud [14]. The intermediate layers provide processing without transferring data to the

* Correspondence to: Department of CSE Islamic University of Science and Technology, Awantipora 192122, India.
E-mail addresses: syed.mujtiba@islamicuniversity.edu.in (S.M. Hussain), grbegh@nitsri.net (G.R. Begh).

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