HYBRID DYNAMIC LOAD BALANCING ALGORITHM FOR CLOUD PERFORMANCE IMPROVEMENT

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A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ENGINEERING (M.Eng.) DEGREE IN COMPUTER ENGINEERING IN THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY, OTA, OGUN STATE

JANUARY, 2023

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Engineering in Computer Engineering in the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Nigeria.

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DECLARATION

I, OBIAZI, OGHORCHUKWUYEM ORIEKOSE (20PCJ02084) declare that this dissertation is a representation of my work and is written and implemented by me under the supervision of Dr. Adewale, Adeyinka A. of the Department of Electrical and Information Engineering, Covenant University. I attest that this dissertation has in no way been submitted either wholly or partially to any other university or institution of higher learning for the award of a masters' degree. All information cited from published and unpublished literature has been duly referenced.

OBIAZI, OGHORCHUKWUYEM ORIEKOSE 12/01/2023

Signature and Date

CERTIFICATION

This is to certify that this dissertation titled "**HYBRID DYNAMIC LOAD BALANCING ALGORITHM FOR CLOUD PERFORMANCE IMPROVEMENT**" is an original research work carried out by **OBIAZI, OGHORCHUKWUYEM ORIEKOSE** meets the requirements and regulations governing the award of Master of Engineering (M.Eng) degree in Computer Engineering from the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, and is approved for its contributions to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to God. His consuming love, favour, and grace were especially evident throughout this research. To my parents, Engr. Prof. And Dr. Mrs. Obiazi, Thank you for everything. For the encouragement, the love, the support, the advice. Thank you for going above and beyond the standard definition of parenthood. To my husband Peter Idoko Alexander, Thanks for being my strength throughout this research.

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LIST OF ABBREVIATIONS

Ant Colony Optimization (ACO)

Application Specific Integrated Circuits (ASICs)

Artificial intelligence (AI)

Client Service Side (CSS)

Cloud Service Provider (CSP)

Data Centre (DC)

Deep Q-Learning Task Scheduling (DQTS)

First Come First Serve (FCFS)

Genetic Algorithm (GA)

Honey Bee Foraging (HBF)

Information and communication technology (ICT)

Infrastructure-as-a-Service (IAAS)

Load Balancing as a Service (LBaaS)

Machine learning (ML)

Max-Min Scheduling Algorithm (MMSIA)

Million Instructions Per Second (MIPS)

Millions of Instructions (MI)

Opportunistic Load Balancing (OLB)

Physical Machine (PM)

Platform As a Service (PAAS)

Q-learning based task scheduling framework for energy-efficient cloud computing (QEEC)

Quality of Service (QoS)

Round Robin (RR)

Service Level Agreements (SLAs)

Shortest Job First - Extreme Learning Machine (SJF-ELM)

Shortest Job First (SJF)

Software As a Service (SAAS).

Virtual Machine (VM)

Virtual Passive Optical Network (VPON)

Virtual Private Networks (VPN)

Weighted Round Robin (WRR)

ABSTRACT

Cloud computing is a modern robust approach, enabling individuals and businesses to buy the services they need per their demands over the internet. It offers a wide range of amenities such as easy access to online applications and services, storage, deployment platforms, and much more. Load balancing is a crucial component of cloud computing, and it prevents the overburdening of nodes while others are idle or underutilized. Maintaining the Quality of Service (QoS) parameters can be difficult for cloud providers when equal workload distribution across servers is a challenge. An effective Load Balancing (LB) approach should enhance and provide a high level of customer satisfaction by effectively utilizing Virtual Machines across servers. Even though load balancing algorithms (LBA) have been the subject of much research, efforts to decrease runtime, makespan, and boost throughput have not yielded satisfactory results. Through the hybridization of a dynamic load balancing algorithm and a machine learning algorithm, this research intends to decrease the runtime of load balancing activities, decrease makespan, and boost task throughput in a cloud computing environment. This study combines the Q-learning algorithm with the Honeybee Foraging Load Balancing Algorithm (HBF-LBA). The proposed Honeybee Foraging Q-Learning algorithm (HBFQL) was implemented in the CloudSim simulation environment. The suggested solution successfully decreased runtime by 13.1% and makespan by 8.95% while enhancing throughput by 8.37% during routing operations compared to the Shortest Job First (SJF) algorithm. Compared with the Ant Colony Optimization (ACO), the proposed algorithm reduced runtime by 14.57% and makespan by 13.71% while increasing throughput by 3.43%. This research improved task execution speed by continually monitoring the virtual machine usage history to route tasks to the best available virtual machine and ensure effective task distribution.

Keywords: Cloud Computing, Load balancing, Virtual Machines, Honeybee Foraging, Q-learning