Chapter 7
Optimizing Cloud Computing Performance Through Green Infrastructure Strategies

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ABSTRACT

Cloud Computing transformed the deployment and utilization of IT resources as on-demand, scalable, and cost-effective services. The high growth rate of cloud infrastructure, though, raised issues of power usage, carbon footprint, and the environment. All of these issues are solved by invoking energy-efficient hardware, the use of renewable resources, and green operation of data centers upon realization of Green Infrastructure in cloud computing infrastructure. This study employs a multi-component model integrating atmospheric, terrestrial, geologic, and LiDAR-based urban data to describe resource consumption and environmental effects. Particle Swarm Optimization (PSO) feature selection determines the most significant factors, and a bi-stacked Long Short-Term Memory (LSTM) neural network learns time and space patterns in energy and resource data. The proposed methodology improves maximum workload allocation, energy prediction control, and green cloud operations.

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INTRODUCTION

Cloud computing was a revolutionary technology that provides elastic and on-demand computing resources over the internet. High setup cost, periodic maintenance, and storage have been required for traditional IT infrastructure, which can be avoided with ease using cloud technologies. Cloud computing assists organizations in keeping their enormous data secure without local servers. This feature enables companies to concentrate on core business instead of maintaining IT. In addition, cloud computing enables collaboration through remote access to applications and information. Through enhanced features such as virtualization and containerization, resource allocation is made efficient. Cloud categories such as SaaS, PaaS, and IaaS allow flexibility in terms of dealing with diverse organizational needs. Utilization of the cloud advantageously impacts startups and SMEs as it is cost-effective. Further, cloud solutions ensure scaling at rates above average during high levels of workload. The demand for responsive and dynamic IT infrastructures has rendered cloud computing a requirement for companies in the present era.

Among the most critical reasons why cloud computing is required is to drive operational efficiency. With lesser reliance on physical infrastructure, companies are able to optimize their assets to the maximum and minimize downtime. Cloud platforms enable the automation of disaster recovery and backup and business continuity. They also provide real-time analytics, improving decision-making in various industries. Cloud computing also facilitates business operations on a worldwide scale with access to information from anywhere. Another key benefit is energy efficiency because shared data centers consume less power per workload than single-tenant enterprise servers. Security features such as encryption and multi-factor authentication also secure confidential data. Cloud collaboration tools also improve productivity and collaboration. Organizations are able to try out new solutions without much initial capital investment. Typically, cloud computing enables organizations to be responsive, economical, and competitive.

Green infrastructure means computer practices and hardware that are environmentally friendly and adopted to conserve energy and lower emissions of carbon. With the environmental impact of traditional data centers expanding, green infrastructure is specifically focused on using renewable power and power-conserving hardware. It uses power-saving methods such as dynamic voltage scaling and power-saving cooling systems. Green infrastructure is needed because the globe is being pushed towards greenhouse gas emissions reduction and climate change mitigation. More and more companies and governments are forced to incorporate green IT solutions in an attempt to achieve their sustainability agendas. Solar, wind, or hydroelectric energy would be used to power green data centers. Green infrastructure and cloud computing complement each other since the cloud providers will tend to be energy