National Research Journal of Information Technology & Information Science
Volume No: 13, (January) Year: 2026 (Special Issue)
PP: 7-10
ISSN: 2350-1278
Peer Reviewed & Refereed Journal (IF: 7.9)
Journal Website www.nrjitis.in

AN EXTENSIVE ANALYSIS OF GREEN COMPUTING: BENEFITS, CHALLENGES AND ROLE

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ABSTRACT

The phrase "green computing" refers to the methods employed by the sector to reduce the amount of hazardous elements released into the environment as a result of the use of ICT resources. About 2% of carbon emissions come from this use, which is equivalent to aircraft. This information inspired the idea of green computing, or environmentally friendly computing. Numerous gadgets, mechanisms, and software have been created as a result of advancements in modern technology, and numerous studies have been carried out to maximize and expand the green computing capabilities of these technologies. Therefore, to determine the current developments, difficulties, and prospects for further research, a review and summary of studies based on green computing are necessary. Through an exploration of the twelve areas of green computing, this study reviewed and summarized green computing in each area study. Following a comprehensive comparison and analysis, this study offers answers to the suggested cutting-edge research questions. Additionally, this study outlines the present difficulties and prospects for further research in each field of green computing. This study will offer insights and ideas to institutions, researchers, and organizations involved in green computing research. Additionally, environmental groups, businesses, and government organizations working to lower energy use and carbon emissions will also gain from this review study.

Keywords: Green Computing, ICT, Carbon, Energy, Environment.

1. INTRODUCTION

Green computing, also known as sustainable computing, is the process of designing and using computer chips, systems, and software to maximize energy efficiency and minimize environmental effect. Green computing's primary goals are to minimize the use of hazardous chemicals, increase energy efficiency over the course of a product's life, and encourage the recycling or biodegradation of outdated goods and industrial waste. The creation of energy- efficient CPUs, servers, peripherals, and computing systems; the promotion of shared services to reduce resource consumption; and the creation of algorithms and systems for effective resource use are all examples of contemporary green computing practices

When a computer or IT system is designed, manufactured, used, and disposed of with the least amount of environmental impact feasible, it is considered green. Stated differently, a green project takes into account all aspect of a computer's life, from design to disposal. A green computer is designed to function without having an adverse effect on the environment. Everything from components and materials to the computer's power supply usage is part of this design. These days, the majority of computers have a sleep or hibernate mode that enables them to reduce their energy consumption when not in use.

These days, four primary complimentary strategies are used to raise social awareness and promote green technological solutions:

Green Use: lowering computer, information system, and peripheral subsystem power usage in an eco-friendly way.

Green Disposal: Reusing and refurbishing outdated computers and other electronic-related items is known as "green disposal." IT providers employ their "take back" policy to recycle unwanted used computers and other electronic waste in order to assume accountability for the complete lifecycle of the items they manufacture.

Green Design: A more comprehensive approach that links businesses, governmental organizations, and environmental groups to create innovative business, regulatory, and management practices that can boost economic growth and environmental quality ==. In a limited and useful sense, creating environmentally friendly and power-efficient computers and its subsystems, such as servers and cooling devices.

Green fabrication: The fabrication of computers and related gadgets uses biodegradable components and manufacturing techniques that have little to no environmental impact. Economic advantages including long-term cost reductions and increased business process efficiency are made possible by this strategy.

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2. HISTORY

Examining the origins and history of green technology is crucial to comprehending its development and effects on modern society. Although "green technology" may seem like a relatively new word, its basic ideas have existed throughout history in many different cultures.

The late 1960s and early 1970s saw the beginning of the green computer era. At this time, the expansion of data centers led to a rise in energy consumption. The massive mainframe computers in these centers consumed a lot of electricity. Green computing began to gain popularity in 1992 when the EPA launched the Energy Star program. The initiative promoted energy-efficient devices and practices, such as electronics. In the IT industry, it was a pivotal time for environmental consciousness. Numerous efforts have been made since then to reduce energy use and encourage environmentally friendly practices in green computing. These initiatives address worries about carbon emissions and how they affect the environment. Green computing also encourages ethical business practices and sustainability. By utilizing power management and energy-saving technologies, the IT industry is currently transitioning to green computing. Additionally, they are investigating renewable energy sources. Additionally, companies are reducing their environmental impact by implementing green manufacturing.

3. CREATIVE APPROACHES

TO GREEN COMPUTING

Cloud computing: By consolidating resources into cloud services, companies can eliminate the need for separate servers spread across several sites, which lowers overall power usage and improves energy efficiency.

Use of Sustainable Materials: By including recyclable or biodegradable materials into hardware design, innovations might reduce environmental harm caused by products that are subsequently abandoned.

Green Data Centers: Green Data Ceters are made to be as environmentally friendly and energy-efficient as possible. Energy-efficient building designs, sophisticated cooling systems, and the use of renewable energy sources are examples of innovations.

Energy Harvesting: Energy Harvesting lessens reliance on non-renewable energy sources by catching and using environmental energy, such as solar or kinetic energy, to power equipment.

Advanced Power Supply: Energy waste may be greatly decreased by putting in place smart power supply systems that automatically modify energy consumption based on workload.

Algorithmic Efficiency: Reducing computer energy consumption is achieved by creating software and algorithms that use less processing power.

4. KEY PRINCIPLE OF GREEN TECHNOLOGY

The foundation of green technology is the promotion of sustainability, energy conservation, and pollution reduction. Its basic pillars are:

Energy Efficiency: Green technology aims to create gadgets and systems that use less energy, which lowers greenhouse gas emissions and energy consumption.

Use of Renewable Energy Sources: Rather than depending on unsustainable fossil fuels, it encourages the use of renewable energy sources including solar, wind, and hydroelectric power.

Recycling and Waste Management: Green technology looks for ways to reduce the quantity of garbage that ends up in landfills by recycling and reusing resources.

Sustainable design: It is the process of designing structures and goods to be long- lasting, effective, and ecologically friendly from the ground up.

5. GREEN COMPUTING MERITS AND

DEMRITS

MERITS	DEMERITS
• Environmental Protection	• Embedded Corporate Culture
• Long-term Sustainability	• Lack of Tax Incentives
• Increased Efficiency	• High Initial Costs

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• Reduced Electronic Waste	• Limited Awareness
• Heat Recycling	• Regulatory hurdles
• Improved Corporate Image	• Rapid Tech Development
• Job Creation	• Lack of Green Computing Expertise
• Emission Reduction	• Electronic Waste
• Cost Saving	• Equipment Replacement Costs
• Optimizing power consumption	• Upgrades to Leased Space

ROLE OF GREEN COMPUTING

Reduce Energy Use: Green computing can assist businesses in lowering their carbon footprint and energy expenses.

Reducing down on Electronic Trash: By implementing strategies such as recycling old devices, promoting the use of energy-efficient equipment, and encouraging consumers to choose durable products, we can significantly minimize electronic trash. This not only helps the environment but also fosters a culture of sustainability within communities

Enhancing sustainability: Businesses can increase their sustainability with the use of green computing.

Saving Money: Green computing not only lowers costs but also enhances a company's reputation as an environmentally responsible organization. By investing in energy-efficient technologies and practices, businesses can contribute to sustainability while enjoying long-term financial benefits

Enhancing Brand Image: This approach not only demonstrates a commitment to environmental sustainability but also appeals to a growing demographic of eco-conscious consumers. By adopting energy-efficient technologies and sustainable practices, companies can strengthen their reputation and foster customer loyalty

Regulatory Compliance: Green computing can assist businesses in meeting legal requirements.

Marketing Advantage: Businesses can outperform rivals in the marketplace by implementing green computing.

CONCLUSION

Green computing, which combines environmentally beneficial methods with new technology, is essential to creating a sustainable future. Businesses can maximize operational efficiency and significantly lessen their environmental effect by investing in renewable energy, virtualization, and energy-efficient technology. Recycling and appropriate e-waste management are two more ways to improve sustainability initiatives. In the end, using green computing helps achieve environmental objectives while also bringing a company into compliance with international sustainability requirements, improving its reputation, and generating long-term financial gains. Adopting these procedures is a calculated step toward a technology environment that is more accountable and resource-efficient.

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