Green Computing On Energy Savings

Nitesh Kushwaha

Research Scholar AKS University Satna

Dr.Akhilesh A. Waoo

AKS University Satna

ABSTRACT

The minimization of hazardous materials, the maximisation of output from the product throughout its lifespan while simultaneously minimising energy consumption, as well as the reusability or recyclability of old products and wastes, and the biodegradability of wastes and waste products are all examples of what this entails. Numerous business organisations are implementing various programmes in order to lessen the negative effects that their activities have on the surrounding environment. United Nations Framework Convention on Climate Change is a worldwide environment treaty whose purpose is to stabilise the production of greenhouse gases in the atmosphere at a level that would avoid hazardous anthropogenic interference with the eco system. When we talk about sustainable development, we are referring to the process of developing without compromising the needs of future generations. This involves achieving the aims of human growth while also protecting the natural resources and ecosystems that are essential to the functioning of civilization. The purpose of this paper is to provide a comprehensive overview of a number of significant recent studies that are associated with the topic of green computing. These studies highlight the significance of green computing for the preservation of the environment.

Keywords: communications technology, environment, green computing

INTRODUCTION

According to the earliest and most extensive research on computers, carbon dioxide (CO_2) and other forms of pollution are causing damage to the climate and ecosystems of the planet via their emission of carbon dioxide. The protection of life is the fundamental and reasonable goal of the environment that we are attempting to safeguard. In the process of creating electronic equipment, researchers and experts have concentrated a significant amount of work on minimising the amount of electronic waste and making use of materials that are not harmful. In light of the fact that the cost of energy continues to rise, the future of information and communication technologies (ICT) will be more dependent on energy efficiency. In view of the expanding usage of information and communications technology (ICT), rising energy costs, and the need to reduce emissions of greenhouse gases, there is a demand for technologies that reduce the overall energy consumption of computing, storage, and communications. The findings of the earliest and most thorough research indicate that emissions of carbon dioxide

and other gases are causing significant damage to the environment as well as the climate on a global scale. In light of this, the primary objective and responsibility of those who work in green computing is to protect our world. According to research conducted by "The Climate Group" and named "Smart 2020" the greenhouse gas emissions that are produced by the Internet business are anticipated to rise to around 1.3 gigatons of carbon dioxide and other greenhouse gases. Nevertheless, the combined impacts of smart grid, smart logistics, smart buildings, and videoconferencing have the potential to accomplish a reduction in emissions of around 7.8 tonnes.

PRESENT TENDENCES

At the moment, green computing is moving in the direction of improved resource efficiency. It is believed that energy is the key resource, and that carbon footprints are the major environmental thread that runs through the system. As a result, improvement of computing performance while simultaneously reducing energy consumption and carbon footprints is the primary goal. In a variety of domains, researchers are exerting a great deal of effort in order to achieve the results they want:

- **Energy Use**

Businesses are becoming more conscious of the extent to which their energy use, both in terms of the source and the amount, contributes to the generation of greenhouse gases. In light of this discovery, organisations are now using the equation that is shown below: Reduced energy consumption results in reduced emissions of greenhouse gases, which in turn reduces the costs associated with running a data centre.

Therefore, the optimal architectural paradigm is to adopt fewer systems that are more energy-efficient and to remodel application settings in order to optimise the utilisation of physical resources. According to the Environmental Protection Agency, around thirty percent to forty percent of personal computers are left "ON" during business hours and on weekends, and even approximately ninety percent of those machines stay dormant outside of those times.

- **Recycling of E-Waste**

According to estimates provided by Gartner, less than ten percent of all electronic devices are now recycled, and more than thirteen hundred and thirty thousand personal computers are discarded every single day by households and businesses in the United States. According to the legislation, electronic firms are obligated to supervise and provide financial support for recycling programmes for their products in the majority of countries, especially those that are considered to be developing nations. Computing that is environmentally friendly must take into consideration the whole of the product's life cycle, beginning with its production and ending with its disposal. Reusing and recycling electronic trash is a straightforward and manageable component of the waste stream. The recycling of materials such as lead and mercury makes it feasible to replace computer equipment that would have been manufactured otherwise. The reuse of such technology allows for the saving of energy and reduces the environmental harm that may be caused by electronic waste.

- **Virtualization**

One essential element of environmentally responsible computing is the virtualization of computer resources. The abstraction of computer resources is what virtualization refers to. For example, virtualization allows for the functioning of two or more logical computer systems over a single physical hardware configuration. Virtualization is the virtualization trend in green computing. In addition to virtualization software, it offers management solutions for environments that are virtualized. In order to become environmentally conscious and preserve sufficient space, sufficient resources, and the environment, one of the most effective techniques is to simplify procedures via the use of virtualization. This kind of environmentally friendly computing will lead to an increase in the consolidation of servers and will also enhance computer security. With virtualization, it is possible to achieve higher levels of system utilisation on a smaller number of computers. The full utilisation of computer resources is made easier by the usage of virtualization, which also provides benefits in:

- The cost may be decreased by reducing the overall quantity of hardware,

- turning down idle virtual servers to save energy and resources,

- And lowering the total amount of space, air, and rent needed.

CHALLENGES

In the past, academics focused their attention on computer efficiency and the costs associated with information technology (IT) equipment and infrastructure services, which were considered to be accessible and could be purchased economically. Infrastructure is becoming the bottleneck in organisations that deal with information technology as a result of increased processing demands, rising energy prices, and global warming. In the field of information technology, this transition presents a considerable difficulty. Because of this, the primary areas of focus for research are now the cooling system, the power, and the space inside the data centre. When it comes to business, processing power is of the utmost importance. On the other hand, infrastructure limits, transportation, and the difficulty of developing an ecologically friendly system are all important factors to consider. Both customers and sellers of information technology equipment are impacted by the challenges made by green computing. Several important providers have made significant progress in this area, which has led to the achievement of significant enhancements. To provide just one example, Hewlett-Packard has just introduced the HP rp5700 desktop personal computer, which the firm describes as "the greenest computer ever." Ninety percent of the materials that make up the HP RP5700 are recyclable, and it is projected that it will have a lifetime of at least five years, which is longer than the standards set out by the United States Energy Star 4.0 programme.

REVIEW OF LITERATURE

Tariq Rahim Soomro (2018) In recent years, the focus of attention in the subject of "Green Computing" has switched from study into energy-saving methods for personal computers to research into energy-saving approaches for corporate systems' client and server machines. This movement in focus has occurred as a result of a shift in the research that has been conducted. One of the many advantages that can be gained by using green computing is the decrease of carbon footprints, which can also be referred to as the saving of energy. In the realm

of environmentally friendly computing, research is being carried out that spans a wider range of topics than just the reduction of carbon footprints and the conservation of energy supply. This research aims to provide a comprehensive overview of green computing in order to fulfil its goal. The focus of this research is on the current trends in green computing, as well as the challenges that are now being encountered in the field of green computing and the next trends that will be observed in green computing.

Ahamed Shibly (2019) In recent years, 'Green Computing' has shifted its focus from studying energy-saving methods for household computers to studying these same methods for the Client and Server machines used by corporate systems. We must discover a mechanism to manage computers and their equipment in order to protect society and the environment from these E-hazards. A concise overview of Green Computing is given in this paper. Green computing's present state, its obstacles, and its potential future developments are the primary foci of this research. Because this study is qualitative in nature, the researcher relied on in-depth interviews and participant observation to compile the necessary data. The information technology sector as a whole is working towards the goal of green computing. The main steps towards green computing include recycling equipment, cutting down on paper use, using virtualization, cloud computing, managing power, and green manufacturing.

Shrddha Sagar (2020) In the contemporary world, one of the areas receiving the most attention is green computing. Key elements of computing and communication networks in Green Computing include systems and software architectures. Because of the increase in internet consumption, green computing is necessary to offset the cost of higher power and cooling prices. With an emphasis on virtualization, connectivity, power management, and material recycling, green computing aims to save the environment. In order to reduce the adverse effects on the environment globally, we need to improve computer and business users' work habits. These types of issues have led to the use of several strategies to reduce computer power usage by academics. In this chapter, we have discussed green computing and its approaches. In this field, authors have also noticed the problem.

Geofrey Nyabuto (2024) A computer technique or practice that is aimed at decreasing any negative influence that computing technology has on the environment is referred to as green computing, which is also referred to as green information and communication technology (ICT). As a result of the continuous development of technology, new technological gadgets are being created, each of which has the potential to have a different impact on the environment. The purpose of this study is to look at a variety of different areas of green computing. All of the most recent research was taken into consideration from the most prestigious scientific magazine in the world, which is IEEE. Additionally, comparisons were made between the countries in where the study was conducted and the year in which the studies were completed and published. A

METHOD AND GREEN COMPUTING

Humans are using Earth's natural resources more quickly than ever before. There are many different types of natural resources, including those that are organic or inorganic, solid, liquid, or gas, metallic or non-metallic, and renewable or non-renewable (Singh, Singh, Tripathi, Agrawal, & Ghoshal). Air, coal, minerals, natural gas, oil, sunshine, water, animals, and plants are examples of basic elements that are considered natural resources (U.S. EPA, 2005). With the help of natural resources, the earth sustains the ecosystem for uninterrupted cyclic seasons. Natural resources are essential to human survival since they provide us with food, biomass, health, leisure, and

enhanced living conditions. In addition, they indirectly regulate the climate, prevent flooding, guard against storms, and cycle nutrients (R.M., 1961). The environment is impacted by the ongoing use of natural resources, which has an impact on sustainability. Sustainability in development is necessary for the welfare of all living things on Earth. Natural resources are something that humans cannot create; instead, they are dependent upon them, either directly or indirectly (Progress.org, 2018). In addition to using natural resources for consumption, people have begun to ruin them for selfish or luxurious purposes. Every opulent need depletes or uses a disproportionate amount of vast natural resources, raising concerns about sustainability.

RESULT AND DISCUSSION

Using green computing is necessary in order to maintain a clean and secure environment. A steady development that satisfies the requirements of the present without having an impact on the requirements of the future is an example of sustainable development. In light of this, it is imperative that environmental consciousness be directed towards future generations. Because of this, the study is centred on the manner in which students make use of and dispose of their computer gadgets. The purpose of this study is to gain an understanding of the level of awareness and knowledge that students have regarding green computing, to gain an understanding of the purchasing behaviour of students when they are purchasing computing devices, to analyse the usage pattern of computing devices by students, to identify the green practices that students follow when using computing devices, and to investigate the disposal behaviour of students when using computing devices.

STUDENTS' AWARENESS AND COMPREHENSION OF GREEN COMPUTING

Having awareness is the first step in any growth. This part addresses the level of awareness and knowledge that students have regarding environmentally friendly computing. The condition or quality of being aware of something is the concept of awareness. In other words, knowledge is the state of being aware of something. The students' awareness and understanding of environmentally friendly computing is evaluated based on a number of different criteria, which are detailed in more detail below.

Students' Awareness of Green Computing

Students' awareness is evaluated based on a number of different criteria, including their familiarity with the concept of green computing, their knowledge of the sources of information on green computing, their knowledge of star certifications, and their knowledge of freestanding printers, all of which are mentioned further down in this article.

Recognizing the Meaning of "Green Computing"

The concept of "green computing" refers to the use and disposal of computers in a manner that has a minimum or nonexistent impact on the environment. A question with a closed-ended format is posed to the respondents, asking them whether or not they are familiar with the concept of green computing prior to filling out this questionnaire. Table 4.2 is a tabular overview of the replies.

Table 1 Acquiring Knowledge about the Concept of Green Computing

Green Computing	Responses	Per cent
Aware	94	15.49
Not aware	513	84.51
Total	**607**	**100**

It can be deduced from the data shown in table 4.2 that the vast majority of respondents are not familiar with the concept of green computing, which accounts for 84.51% of the total, while only 15.49% of the respondents are aware of the phrase green computing. It is deduced that just a small percentage of respondents were familiar with the concept of green computing.

Sexuality and Knowledge of the Term "Green Computing"

In table 4.3, the association between awareness of the term "green computing" and sexual orientation is shown that is presented. In order to test the hypothesis that "There is no significant relationship between Sex and Awareness of the term green computing," the data were evaluated using the Chi square test.

Table 2 Awareness of the term "green computing" and sexuality

Sex	Awareness of Green Computing		Total	Chi-Square
	Aware	Not Aware		
Male	57	171	228	25.255
Female	37	342	379	df = 1
Total	94	513	607	P Value = .000

We were able to deduce that the Pearson Chi-Square value was 25.255, the degrees of freedom were equal to one, and the P-Value was equal to 0.000. In light of the fact that the P value is lower than the significant value of 0.05 that was selected, the Null Hypothesis is rejected. It may be concluded that there is a substantial connection between the concept of green computing and the gender of the individual. It appears that male respondents have a greater awareness of environmentally friendly computing than female respondents do. Additionally, it has been ascertained that the majority of the female respondents are not familiar with the concept of green computing.

Age and the level of familiarity with the term "green computing"

Table 4.4 illustrates the fact that there is a correlation between age and awareness of the phrase "green computing." In order to test the hypothesis that "The age of the individual does not have a significant association with their awareness of the phrase "green computing." the data were collected and analysed using the Chi square test.

Table 3 Age and the level of familiarity with the term "green computing"

Age	Awareness of Green Computing		Total	Chi-Square
	Aware	**Not Aware**		
Up to 16	18	86	104	
17 to 20	26	253	279	18.846
21 to 22	29	119	148	df = 3
23 and above	21	55	76	P Value $= 0.000$
Total	**94**	**513**	**607**	

It can be deduced from the data shown in table 4.4 that the Pearson Chi-Square value is 18.846, the degrees of freedom are 3, and the P-Value is 0.000. In light of the fact that the P value is lower than the significant value of 0.05 that was selected, the Null Hypothesis is rejected. Therefore, there is a correlation between the ability to recognise the word "green computing" and one's age. When compared to respondents of other age groups, those who are in the age group of 23 years and older are more likely to be familiar with the term "green computing." Among the respondents who fall between the age range of 17 to 20, it has been noted that the majority of them are not familiar with the phrase "green computing." In light of this, it can be deduced that the level of consciousness possessed by the respondents rises in tandem with their age.

CONCLUSION

The researcher was able to find a great deal of key aspects that have to be taken into account while doing study on green computing as a result of taking the time to read a number of research publications. Based on the data, it was discovered that there were not many studies conducted in India. However, a lot of studies are focusing on the electrical waste that is created by computing devices, but only a limited number of research projects are focusing on the consumption pattern of computer equipment. The researcher came to the conclusion that there were no studies concerning the utilisation and disposal of computer equipment. This was one of the results that the researcher discovered. Furthermore, there was no study carried out from the perspective of a college student whose perspective was being considered. As a result of this, the researcher made the decision to make an attempt to fill the research gap that had been discovered by conducting a study with the title "Green computing device – An analysis on use and disposal behaviour among students." Using the information that was acquired from college

students in the southern areas of Tamilnadan, the researcher went into great depth on the objectives that were to be accomplished in this chapter. The research investigation uncovered a diverse array of behaviours shown by college students in connection to computing that is friendly to the environment.

REFRENCES

[1]   Gourav, Kumar & Kohli, Garima & Ratta, Pranav & Jammu, Jammu & Kashmir, India. (2018). Green Computing -Trends and Challenges. 10.32628/CSEIT411854.

[2]   Soomro, Tariq & Sarwar, Muhammad. (2012). Green Computing: From Current to Future Trends.

[3]   Shibly, Ahamed. (2015). Green Computing: - Emerging Issue in IT. 10.13140/RG.2.1.1729.4248.

[4]   Sagar, Shrddha & Pradhan, Nilanjana. (2020). A Review: Recent Trends in Green Computing. 10.1007/978-3-030-48141-4_2.

[5]   Nyabuto, Geofrey. (2024). A Review of Current Research Trends in Green Computing. East African Journal of Information Technology. 7. 51-59. 10.37284/eajit.7.1.1707.

[6]   Jindal, Gaurav & Gupta, Manisha. (2012). Green Computing " Future of Computers ". International Journal of Emerging Research in Management &Technology. 14-18.

[7]   Bose, Anindya & Nag, Sanjay. (2022). Green Computing – A Survey of the Current Technologies. Asia-Pacific Journal of Management and Technology. 03. 01-15. 10.46977/apjmt.2022.v03i02.001.

[8]   Mishra, Sushruta. (2020). Green Computing: A Step Towards Eco-Friendly Computing. 10.4018/978-1-5225-5793-7.ch006.

[9]   Paul, Showmick & Saha, Arpa & Arefin, Mohammad & Bhuiyan, Touhid & Biswas, Al Amin & Reza, Ahmed Wasif & Alotaibi, Naif & Alyami, Salem & Moni, Mohammad Ali. (2023). A Comprehensive Review of Green Computing: Past, Present, and Future Research. IEEE Access. 11. 87445-87494. 10.1109/ACCESS.2023.3304332.

[10]   Ray, Ishita. (2012). Green Computing. 10.13140/2.1.1546.0164.

[11]   Jahan, Samreen & Barua, Hrishav. (2019). Recent Trends in Green Computing.

[12]   Pradhan, Nilanjana & Sagar, Shrddha. (2020). "A Review: Recent Trends in Green Computing" Green Computing in Smart Cities: Simulation and Techniques Springer. 10.1007/978-3-030-48141-4.

[13]   Raza, Khalid & Patle, V. & Arya, Sandeep. (2012). A Review on Green Computing for Eco-Friendly and Sustainable IT. J. Comput. Intell. Electron. Syst.. 1. 3-16. 10.1166/jcies.2012.1023.

[14]   Mohiddin, Shaik & Suresh Babu, Yashashwini. (2015). Green Computing an Eco Friendly It Environment for Upcoming Technologies.

[15]   Sen, Deepanjan & Chowdhury, Dilip. (2016). Green Computing : Efficient Practices And Applications. INTERNATIONAL JOURNAL OF COMPUTER SCIENCES AND ENGINEERING. 04. 38-47. 10.5281/zenodo.5226613.

[16]   Gopala, Mr & Sriram, Gopala. (2022). Green Cloud Computing: An Approach Towards Sustainability. 10.0202/Sustaina.2022634787.

[17]   Agarwal, Shalabh & Nath, Asoke & Bhaumik, Ankita & CHAKRABARTY, SHAMIK. (2015). TRENDS AND AWARENESS IN GREEN COMPUTING INITIATIVES : A COMPREHENSIVE STUDY.

[18]   Roy Chowdhury, Chiranjeeb & Chatterjee, Arindam & Sardar, Alap & Agarwal, Shalabh & Nath, Asoke. (2013). A Comprehensive study on Cloud Green Computing: To Reduce Carbon Footprints Using Clouds. International Journal of Advanced Computer Research. 3. 78-85.

[19]   Singh, Shailendra & Gond, Sunita. (2015). Green Computing and Its Impact. 10.4018/978-1-5225-0788-8.ch062.

[20]   Atrey, Ankita & Jain, Nikita & Iyenger, N Ch Sriman Narayana. (2013). A Study on Green Cloud Computing. International Journal of Grid and Distributed Computing. 6. 93-102. 10.14257/ijgdc.2013.6.6.08.