Green Computing: An Environmental Friendly Way Of Computation

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Abstract
The requirement for pro-environmental computational devices and power conserving gadgets, defined by “Green Computing " is emerging as an international process with the target to decrease environmental degradation that is caused from daily rise in the amount of e-waste generated. “Green computing” presents a pro-environmental method to decrease the energy utilization by the computational gadgets and reduces the quantity of e-waste generated.

It is a way of utilizing the computational devices in an efficient manner. The prime motive is to decrease the utilization of hazardous elements, enhance power efficiency throughout the life of a computational device and promote the usage of recyclable or biodegradable material.

Green computing relates to the design of electronic computational devices that are energy efficient and have high performance. Global warming is concerned with the regular increase in the temperature of earth that inturn is resulting in the melting of the glaciers on the poles of the earth. UNFCCC is continuously working to attain the goal of preventing the changes in the climate due to global warming, etc.

Keywords: Green computing, sustainable development, recycling, global warming.

1. Introduction
Computers consist of a set of components designed to aid Homosapiens in daily life. But there exist several adverse impacts of computers[1]. These devices are a massive source to generate heat and carbon-di-oxide, e-waste and consume huge amounts of power[2]. This view of computer seems to affect the atmosphere[3].

Green computing is a step taken in the direction of the conservation of the environment by modifying the manner of usage of computational devices[4]. It is not limited to the utility of electronic components but it can be used in different phases of components like designing, developing and disposing[5]. Green computing is concerned with the development of electronic products which are recyclable and generates a minimal amount of e-waste. Green technology is concerned with reducing the carbon and its effects on the environment[6].

The thought of green computing was initiated with the launch of energy-star by a US based pro-environmental agency in 1992[7]. Energy star rating is a system to label the cooling fans and display devices, etc. Sleep mode was the initial step taken to implement green computing[8]. It helps in conserving energy when the device is not in use. Nowadays green computing is focusing on e-waste management and energy conservation[9].

Green computing is the term used to denote efficient use of resources in computing[10]. This term generally relates to the use of computing resources in conjunction with minimizing environmental impact, maximizing economic viability[11]. Green computing is concerned with minimizing the usage of substances like CFC which are harmful to the environment and motivate the usage of recyclable and biodegradable material[12].

The rest of the article is presented as follows: Section 2 describes the literature review. Imp

The base objectives of green computing are as follows:
- To minimise the energy consumed by the devices to every possible extent
- To reduce the usage of hazardous materials.
- To prefer the usage of biodegradable materials.

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2. Literature Review
A number of laws and regulations are formed by the government and private bodies to enforce the concept of green computing. The government has to make various rules and regulations in order to minimise the production of e-waste. The government should conduct and encourage various activities in order to spread awareness among the users about the e-waste and its adverse impact on nature. The initiatives need to be taken by the government in order to spread awareness about the harmful impact of E-waste on nature. There are too many researchers who have enlisted the rules and regulations used throughout the world in order to promote the green-IT.

- The 2003 directive a European Waste and Electrical Equipment made it necessary for the manufacturers to take the old returned electronic equipment without any charge. This sleep was taken to minimise the otherwise produced electronic waste.
- In 2007 the European directive restricted the use of several materials such as mercury, lead, cadmium, etc. These materials were used in the manufacture of electronic products.
- In 2007 the regulations regarding the life cycles of the electronic components were also addressed by the European Union.
- The energy star ratings were given to the electronic components (2009), so as to make the customers understand the efficiency of the product he/she is going to purchase.

In this section a survey of some very important literature on green computing is carried out under the following subheadings.

3. IT and Nature
Extensive utilization of computers in the field of computer science and engineering has widely affected environment in following ways:
The increasing quantity of carbon di-oxide has contributed a lot in the increase of green-house effect which is causing global warming. Usage of electricity by the computational and electronics as well as electric appliances is a major contributor in the generation of carbon di-oxide as the thermal plants which are major producers of electricity are also generating huge amounts of CO2 in this process. Production of computational equipment leads to the usage of large quantities of chemical and harmful substances which are hard to dispose after the life time of the component. Moreover the increasing demand of automation and computation is enhancing the process of utilisation of all such products which is posing a great harm to the environment by directly or indirectly producing large amounts of carbon emissions.

4. Advantages of green IT
Companies are highly benefited in terms of taxes and other revenues posed by the government if they follow the regulations prescribed by the government and make the equipment as per the norms.

The customers have become more aware about the carbon emission norms and generally demands for the products with last carbon emissions, which can benefit them as will nature.

5. Why adopting green computing
Following are the various factors that impact computers and data-centres:

5.1. Fast internet growth has drastically aided the growth of electronic components and the reliance of human on the internet has dramatically increased the usage of electronic components. This process has resulted in the expansion of the size of data-centres.
5.2. Increasing Equipment Power Density: The advancement in science has resulted in the manufacture of CPUs
which have low power consumption but with the increasing demand of computation the number of CPUs are increasing with such as extent that the overall power requirement is increasing in a drastic manner.

6. Comparative analysis
This section shows the summary and comparison of the main identified categories in The “X” symbol in the box means the identified category has not been mentioned in the interview data for the particular technology (e.g. cloud, mobile).

Table 1. Comparison and tabular analysis.

<table>
<thead>
<tr>
<th>Virtualization and cloud computing</th>
<th>Mobile Computing</th>
<th>Social Computing</th>
<th>Green Computing</th>
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<td>Piloting</td>
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Current section depicts the comparative analysis of energy consumed by various computational equipment used in the IT industry (see Table 1).

7. Power Consumption by PC Components
PCs are extensively used in IT industry. They are used to incorporate the concept automation and ease the task of human but these devices requires a lot of energy for this operation and generates a large amount of carbon-dioxide which in turn leads to global warming.

8. Green computing challenges
As per the researchers in the past the prime focus used to be enhance the efficiency of computational devices and their associated cost. That’s why the researchers are concentrating on the development of power efficient cooling systems for the data-centres and computational centres. In current scenario there exists a trade-off between computational power and energy consumption.

The current era is the time of electronics and computers. These devices contribute a lot to the generation of carbon-di-oxide which is responsible for global warming. Moreover a hefty amount is spent by the users around the globe to power the computers. It is found that approximately 250 billion dollars are spent on the energy required to power the computers while the actual energy utilized while computation was only 15.02% of it. The proper utilization of computational resources would result in reducing the tonnes of carbon emitted per year globally.

The Technology changing all the time and increasing its domain. This leads to the effect that the device which is latest computational device today may become useless in time to come. All credits goes to the advancement in computational technology or electronics technology that the device which enters market soon becomes outdated product. This why the concept of green computing game into light to promote the development of reusable, scalable and energy efficient computational devices in order to protect the nature from the adverse effects of development.

10. Certifications
Various bodies have been formed, that certifies the green systems. The grades are given to the products. Based on their life time, material used and recyclability of the product.
In the time to come these certifications together with government regulations will insist the makers to develop products which are friendlier to the environment.

11. Cloud computing
Cloud Computing has become popular for providing quality services in terms of computation, storage, etc. It has introduced the concept of resource utilization by optimally using the computation resources by sharing them through the cloud platform. The concept widely minimised the purchase of new hardware resources in order to enhance the computational performance. Therefore, it can be concluded that the Cloud Computing enhances the utilization of resources which in turn benefits the environment by reducing the quantity of E-waste generated.

12. Product
According to the reports of Fujitsu & Gartner it is natural that if the computational devices are developed to last long then the amount of E-waste generated by the discarded devices can be reduced to the largest extent. The long life of the devices will make them possible to be used for longer period of time thereby reducing the demand to manufacture the new products. The rules and regulations enforced by the government can force the manufacturers to develop the long lasting products.

13. Power Management Tools
Power management tools are emerging as the most effective solution to reduce the power consumed by the computational devices. Divisions which concentrate on the conservation of energy in IT sector may decrease with the usage of energy management tool. Data from energy star for several installations shows that about 10 to 90 dollar is saved by a computer Per year.

14. Leveraging
The computer resources which are not in use should be shared so that there is proper utilization of the computational resources. Utilizing such resources leads to the economical option for the computational resources. Such activities may promote the concept of reusability thereby reducing the carbon emissions up to 15.01 tons per year and minimise the e-waste by 80%.

15. Data compression
In the organizations a large quantity of data is stored on the regular basis, moreover replica of the data is also maintained as a backup in order to deal with the uncertain or accidental loss of data. This process requires large amount of hardware resources. So, the idea is to compress the data before storing it to the devices.

16. Applications
The prime implementation of the green computing focuses on the following domains.
Design of the products
Recycling
Optimization of the data centres
Virtualization
Indulgence of power management tools

17. Conclusion and future scope
The requirement for pro-environmental computational devices and power conserving gadgets, defined by “Green Computing” is emerging as an international process with the target to decrease environmental degradation that is caused from daily rise in the amount of e-waste generated. “Green computing” presents a pro-environmental method to decrease the energy utilization by the computational gadgets and reduces the quantity of e waste generated.

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It is quite noticeable that the growing IT industry is steadily adding poison to the environment. This needs a necessary action to be taken in order to conserve the environment. Therefore, the green computing is a model to satisfy the increasing requirements of the IT industry without harming the environment. Green computing deals with the recycling of devices, minimising the usage of paper, etc.

Future work in the domain of green computing includes the development of eco-friendly, recyclable computational components which are power efficient and recyclable or serviceable to meet the increasing computational requirements of the IT industry. There is a requirement of extensive research in this domain.

References


