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Green Computing: A Study on Future Computing and Energy Saving Technology.

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Abstract

Currently computers are not only used in offices but also used at home. As the usage of computers is increasing day by day, the energy consumption is growing rapidly which in turns increase the carbon content in atmosphere. Green computing concept is to improve environmental condition. The main aim of green computing is to reduce toxic materials. During recent years, attention in 'Green Computing' has moved the research into energy saving techniques for home computers to enterprise systems' Client and Server machines. Saving energy or reduction of carbon footprints is one of the aspects of Green Computing. This study provides a brief account of Green Computing. The emphasis of this study is on current trends in Green Computing; challenges in the field of Green Computing and the future trends of Green Computing

**Keywords:** Green Computing, Energy, Computer and IT.

1. INTRODUCTION

The term 'Green Computing' is the study and practices of designing IT equipment and their safe disposal efficiently and effectively with negligible or no impact on the environment [1]. Figure 1.1 shows the classification of green computing. It has two factors "Green-IT" means well organized IT and "IT-for Green "means use of IT in an efficient way. First and most conclusive research on computing shows that Carbon Dioxide (Co2) and other emissions are causing global climate and environmental damage. Thus go green is the first and foremost need of modern age that can decrease the overall energy consumption of computation, storage and communications. The 5 core green computing technologies advocated by GCI are Green Data Center, Virtualization, Cloud Computing, Power Optimization and Grid Computing. Company like Via Technology offer green PC's that are affordable, non-toxic and ultra low wattage. It takes responsibility of their outdated products by offering a PC recycling service.

Green computing can also develop solutions that offer benefits by "aligning all IT processes and practices with the core principles of sustainability, which are to reduce, reuse, and recycle; and finding innovative ways to use IT in business processes to deliver sustainability benefits across the enterprise and beyond".

The goals of green computing are quite similar to green chemistry which are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of non-operational products and factory waste [1].
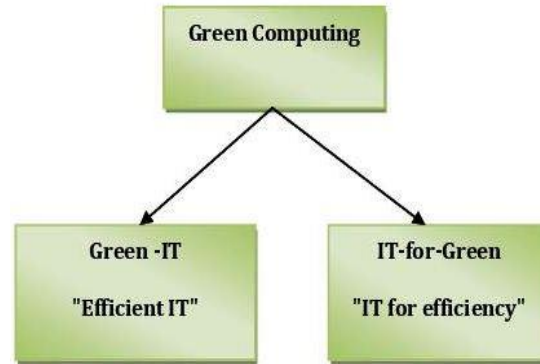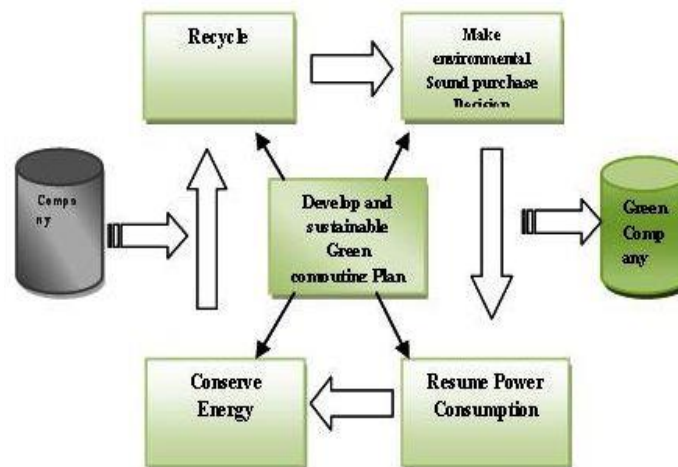
Fig. 1.1: Green Computing Classifications

This technology is beneficial as it:-
a) Reduce energy consumption of computing resources during peak operation.
b) Save energy during idle operation.
c) Use eco-friendly sources of energy.
d) Reduce harmful effects of computing resources.
e) Reduce computing wastes.[3]

Below figure 1.2 shows the framework of green computing.

Fig.1.2: Framework of Green Computing.

These benefits of Green computing can only be achieved by keeping the following points in mind. All points help for reducing energy consumption of computer resources.

a) By using energy star qualified products help a lotin energy conservation.
b) Instead of using regular monitors organic LED should be used.
c) When the computers are turned off, the green computing provides the benefit to cut off the power of peripheral devices.
d)   Donation of old computers and other peripherals reduces the rate generation of e-waste which in terns reduces environmental pollution.

e) Use of computers greatly reduces the use of papers, because a huge amount of data can be stored in Hard Disk of computers and avoids the placing record on papers.

f) To have the record stored in computers in the form of papers, printers can be used but to reduce the paper waste, we should think 3 to 4 times before using printers.

g) Due to rapid development in IT, the games which were stored in a disk are now available on internet, which reduces the problem of using disks and boxes that were required a lot of resources.

h) Use of local cooling software always monitors the activity of CPU and when it sits idle it immediately put it into sleep mode and also manages power consumption.
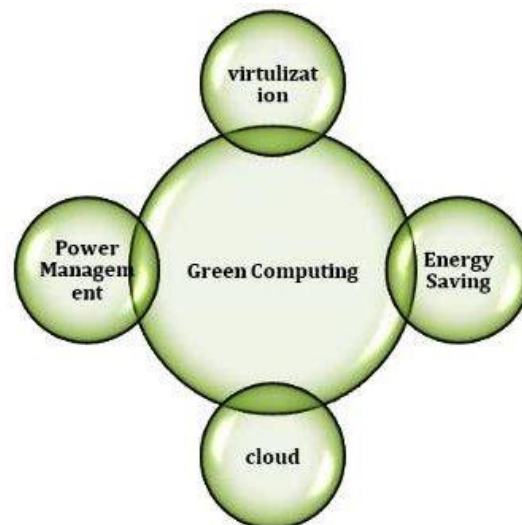
2. NEED OF GREEN COMPUTING

Use of computer system and IT services had made one's life easier and more comfortable. It increases the processing Speed and power consumption also.

This large amount of power consumption increases the emission of green house gases and increases the pollution as well. Energy consumption is also increasing due to, leaving the system on even when they are not being used. Along with this a large amount of energy wasted in IT, because data centers needed lots of power and matching cooling capacity, when it is not available then it causes environmental pollution. Green computing deals with the concept of reducing energy consumption, recycling eliminate hazardous elements but it also deals with reduce in the business travel sharing the resources (cloud computing) and optimization.

There are lots of fundamental steps that can be taken to significantly decrease the power consumption and impact on environment. Figure 2.1 shows the aspects of green computing which are discussed below.

I) *Energy Consumption :*

According to environmental protection agency around 30%to 40% of computers are kept ON during the weekends and even after office hours and around 90% of these computers remain idle. If we develop any application in green computing environment it will use optimal physical resources

Fig-2.1: Fundamental Techniques of Green Computing

II) E-waste recycling:

Many developed countries are stronger in technology hence a huge amount of computer systems and related products are discarded every day. These products are sold out to other developing countries. In this way recycling of electronic products are achieved. Along with this, recycling of materials used in construction of computer hardware such as tin, silicon, iron, aluminum etc and electronic items such as audio visual components, mobile phones and other handheld electronic devices contribute a lot in reducing energy efficiency. Recycling of computing equipment such as lead and mercury enables to replace equipment that otherwise would have been manufactured. The reuse of such equipment's allow saving energy and reducing impact on environment, which can be due to electronic wastes.

III) Virtualization:

With virtualization, a system administrator could combine several physical systems into virtual machines on one single server to run multiple operating systems and make it more powerful. Energy-efficiency can be achieved with less physical equipment plugged in, which reduces power and consume less electricity. Several commercial companies and open-source projects now offer software packages to enable a transition to virtual computing. It is the fact that virtualization alone doesn't maximize energy and resource efficiencies. So, combined with the right skills and operational and architectural standards, automation minimizes the need of physical infrastructure which in turn maximizes the energy and resource efficiencies from server virtualization.

IV) Cloud as a Green computing:

Businesses are rapidly moving from traditional system to cloud based system because of its faster scale-up/scale-down capacity, pay-per-use and access to cloud-based services without buying and managing on-premises infrastructure. The pay-per-use facility of cloud infrastructure provides energy and resource efficiencies simultaneously and Promote users to consume only those resources which are required. An IT organization can achieve energy-efficiency and sustainability goals by moving the load from ordinary servers to cloud servers. But unfortunately IT industries are acquiring the 70 percent of their electricity from greenhouse-gas-emitting fossil fuels, like coal and leaving a significant amount of carbon footprint. If cloud providers want to make their services as a green, they must invest in renewable energy sources. This can be achieved by generating power from renewable sources of energy, like wind, solar, or hydroelectricity. Consolidation of resources can improve utilization and provide more space, power and cooling capacity within the same facility envelope.

3. DEVELOPING A GREEN MACHINE

Power management feature in computer system saves energy and money. To make the computer environment friendly, SLEEP and HIBERNATE settings Can be used. These functions can be activated either by manually or by power Management settings of operating system.

Sleep Mode: When a computer system is inactive for
Sometime then system automatically switches to lower power state. This state is called sleep mode. This state preserves energy by cutting power, display, hard drive, and peripherals. When pressing any key from keyboard, sleep mode deactivate and system takes back to its previous state. This mode mainly conserves battery power in a laptop computer.

Hibernate Mode: When this mode is activated, first data moves to hard disk of system and then system is completely switched off. When the system is turn on, all files and documents appear as it is, as they were left previously. By making the system in hibernate mode, battery power can be save a lot [7].

4. RECENT IMPLEMENTATIONS OF GREEN COMPUTING

i.   Blackle: Blackle is a search - engine site powered by Google Search. Blackle came into being based on the concept that when a computer screen is white, presenting an empty word or the Google home, and your computer consumes 74W. When the screen is black it consumes only 59W.Based on this theory if everyone switched from Google to Blackle, mother earth would save750MW each year. This was a really good implementation of Green Computing. The principle behind Blackle is based on the fact that the display of different colors consumes different amounts of energy on computer monitors.

ii. Fit-PC: a tiny PC that draws only 5w: Fit-PC is the size of a paperback and absolutely silent, yet fit enough to run Windows XP or Linux. Fit-PC is designed to fit where a Standard PC is too bulky, noisy and power hungry. If you ever wished for a PC to be compact, quiet and green then fit-PC is the perfect fit for you. Fit-PC draws only5 Watts, consuming in a day less power than a traditional PC consumes in 1 hour. You can leave fit-PC to work 24/7 without making a dent in your electric bill.

iii. Zonbu Computer: The Zonbu is a new, very energy efficient PC. The Zonbu consumes just one third of the power of a typical light bulb. The device runs the Linux operating system using a1.2 gigahertz processor and 512 Meg of RAM. It also contains no moving parts, and does even contain a fan. You can get one for as little as US$99, but it does require you to sign up for a two-year subscription.

iv. Sunray thin client: Sun Microsystems is reporting increased customer interest in its Sun Ray, a thin desktop client, as electricity prices climb, according to Subodh Bapat, vice president and chief engineer in the Eco Responsibility office at Sun. Thin clients like the Sun Ray consume far less electricity than conventional desktops, he said. A Sun Ray on a desktop consumes 4 to 8 watts of power, because most of the heavy computation is performed by a server. Sun says Sunrays are particularly well suited for cost-sensitive environments such as call centers, education, healthcare, service providers, and finance. PCs have more powerful processors as well as hard drives, something thin clients don't have. Thus, traditional PCs invariably consume a substantially larger amount of power. In the United States, desktops need to consume 50 watts or less in idle mode to qualify for new stringent Energy Star certification.

v.   The Asus Eee PC and other ultra portables: The "ultra-portable" class of personal computers is characterized by a small size, fairly low power CPU, compact screen, low cost and innovations such as using flash memory for storage rather than hard drives with spinning platters. These factors combine to enable them to run more efficiently and use less power than a standard form factor laptop. The Asus Eee PC is one example of an ultraportable. It is the size of a paperback, weighs less than a kilogram, has built-in Wi-Fi and uses flash memory instead of a hard drive. It runs Linux too[5]

5. ENERGY SAVING PROGRAMMES

Many countries now adopted programmes to minimize energy consumption in electronic equipment's. The Climate Savers computing initiative is the programme launched to reduce power consumption in computers. The Green Electronic Council promotes the manufacturing and sale of Green Computers. The Green Grid is a global consortium promoting the use of energy efficient IT devices in data centers and business firms. The Green Comm Challenge is the organization formed to promote energy conservation techniques in the field of Information Technology.

Methods
1. Use of a single hardware to run two or more logical computer systems
2. Use of a terminal server system to connect multiple users to transfer data into a Central server. The central server will process the data. This reduces energy consumption.
3. Power efficiency system can be introduced, so that the computer and peripherals turn off after a period of time if it is not using. The Hibernating mode and advanced power management of modern computers are meant for this.
4. Power supply efficiency of the PC can be increased to 80% from 70% efficiency of the present power supply system.
5. Replacement of CRT monitor with LCD or LED monitors.
6. Reduction in the uses of toxic chemicals such as lead, cadmium, mercury etc. in computer parts.
7. Introduction of recycling programmes in all places to dispose obsolete devices easily.
8. Promotion of telecommuting systems. This reduces the cost, travel expenses, carbon dioxide emission from vehicles etc.

Some Green computing tips
1. If you are not using the computer frequently, purchase a small system with minimum attachments and peripherals.
2. Turn off the computer immediately after the use. Do not keep it in standby mode. Even in the standby mode, it consumes around 10 watts power.
3. Buy a good quality computer with Energy star. Always observe the power consumption.
4. Unplug peripherals such as printer, audio system, scanner, modem etc if these are not using.
5. Do not keep the UPS always switched on. Switch on the UPS only when the computer is using. If you are using the computer for one or two hours daily, that is enough for charging the battery. This prevents overcharging of the battery and reduces the electricity cost.

6. CONCLUSION

To make the computer society completely green, one should do the following things. When computer components are not in our use then the components must be donated to those people who may not have those components. Instead of discarding computers, upgrade their parts in order to make them new. As some components used to build the motherboard of computer are very expensive and toxic then recycling of these components is a better option. Different wallpapers consumes a large amount of energy so instead of setting different wallpapers, set Blackle as home page. Because blackle is a website powered by google custom search whose screen is predominantly black and fonts are of gray color. This arrangement consumes very less

energy. So, Go green is a concept which is used in few organizations but if everyone use its components then it could be beneficial for everyone. The benefits of green computing are clear. As the number of PCs approaches 2 Billion by 2015, the potential savings related to energy use, CO_2 emissions and e-waste are undeniable. Hence proper implementation of Green computing will be helping hand in terms to save energy and remove the pollution.

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