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Green Computing towards Environmental Sustainability

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Abstract: *Green Computing or Green IT is the study and practice of environmentally sustainable computing or IT. Green computing is the environmentally responsible and eco-friendly use of computers and their resources. It can also be broadly defined as the study of designing, manufacturing/engineering, using and disposing of computing devices in a way that reduces their environmental impact.*

The goals of green computing are similar to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, the recyclability or biodegradability of defunct products and factory waste.

Green computing is important for all classes of systems, ranging from handheld systems to large-scale data centres. However, data centres hosting computing applications consume large amounts of energy, which contributes to high operational costs to the environment. With energy shortages and global climate change leading our concerns these days, the power consumption of data centres has become a key issue. Therefore, we need green computing solutions that can not only save energy, but also reduce operational costs. Many corporate IT departments have green computing initiatives to reduce the environmental effect of their IT operations.

The vision for energy efficient management of green computing environments is presented here.

Keywords— *Green IT, Energy efficiency, Environmental sustainability, Reuse, Recycle.*

I. INTRODUCTION

Green Computing or Green IT is the study and practice of environmentally sustainable computing or IT. Green computing is the environmentally responsible and eco-friendly use of computers and their resources. It can also be broadly defined as the study of designing, manufacturing/engineering, using and disposing of computing devices in a way that reduces their environmental impact. The goals of green computing are similar to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, the recyclability or biodegradability of defunct products and factory waste.[1]

II. NEED OF GREEN COMPUTING

Nowadays computer is the basic need of every human. Computers made our life easier and saves a lot of time and human efforts, but the use of computer also increases power consumption and also generate a greater amount of heat. Greater power consumption and greater heat generation means greater emission of greenhouse gases like Carbon Dioxide (CO₂) that has various harmful impacts on our environment and natural resources. This is because we are unaware about the harmful impacts of the use of computer on environment. Personal computers and data centres consume a lot of energy which use various old techniques and they don't have sufficient cooling systems. Resultant is the polluted environment.

There are various reasons for the use of green computing. They are:

- A. Computers and electronic devices consume a lot of electricity that have some harmful impact on our environment.[2]
- B. Most of electronic devices generate a lot of heat which cause the emission of CO₂. CO₂ is one of the greenhouse gases, warming the earth surface to higher temperature by reducing outward radiation and ultimately contributing to global warming.[2]
- C. While disposing of computers, it produces a lot of hazardous waste that are harmful for the environment. It also releases heavy metal like lead (Pb), mercury (Hg), cadmium (Cd) into the air.[2]
- D. The manufacturing of computers product release heavily on the use of toxic chemical for electrical insulation, soldering, and fire protection. Expose the chemical fumes over the long term can cause cancer. All these causes can be reduced using one concept i.e. "Green computing". Now we have to implement the green computing on various electronic and electrical devices to save our environment from these harmful impacts.[2]

III. APPLICATIONS OF GREEN COMPUTING

- A. Efficient resource energy management in data centres today, the perception of cloud computing has not only reshaped the field of distributed systems but also fundamentally changed how businesses utilize computing. [1]
- B. Green cloud computing in energy efficiency cloud computing is a highly scalable and cost-effective infrastructure for running HPC, Enterprise and web applications. [1]
- C. Green parallel computing in big data systems is typically organised around a distributed file system on top of which the parallel algorithms can be executed foie realizing the big data analytics. [1]
- D. In Pre-emptive priority based job scheduling algorithm in Green cloud computing, a packet simulator focuses on maximizing the system throughput with saving energy on different servers. [1]

IV. MERITS OF GREEN COMPUTING [3]

It reduces the environmental impact.

- A. Conserving resources means less energy is required to produce, use and dispose of products and using more renewable energy sources and making devices better recyclable.
- B. Implementing green computing techniques lowers energy costs.
- C. It makes data centres and computing devices more energy efficient.
- D. Using less hazardous materials in computing devices.
- E. It also promotes device longevity.
- F. Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses.
- G. Reduced health risk for computer workers and recyclers.

V. DEMERITS OF GREEN COMPUTING [3]

- A. Rapid changes and enhancements in technology.
- B. Some computers that are actually green may be considerably underpowered.
- C. Green computing setup environment could actually be costly.

VI. HOW GREEN COMPUTING CAN IMPROVE ENERGY EFFICIENCY IN IT

- 1) *Use Energy Star Labelled Products:* All the energy star labelled products are manufactured keeping in mind the idea of less power consumption. These devices are programmed to power-down to a low power state or when they are not in use. So, we have to use "Energy Star" labelled desktops, monitors, laptops, printers and other computing devices.
- 2) *Turn off your computer:* PC's and its peripherals consume more power and resultant is the emission of high amount of CO₂. So, we have to keep that in our mind and must always remember to turn off our personal computers when they are not in use.
- 3) *Sleep Mode:* Sleep mode saves our session and puts our computer in a low power state so that we can quickly resume windows. We must always put our PC's on sleep mode when not in use. It saves around 60-70 percent of electricity.
- 4) *Set a power Plan:* Set an effective power plan to save electricity. Because if our computer consumes more electricity, they produce more harmful impacts on our environment.
- 5) *Avoid Using Screen Saver:* Screen savers also consume electricity even when a computer is not in use. Screen saver can be a graphic, text or an image that shows on computer screen when it is not used for pre-set time. But the best option for energy saving than screen saver is turn off your monitor when not in use.
- 6) *Turn Down Monitor Brightness:* If we use our PC at a high brightness it consumes more electricity than using at a normal brightness. So, we should always turn down our PC's brightness to save electricity.
- 7) *Stop Informal Disposing:* Computer and its components use toxic chemicals when manufactured and when we use informal disposing, they put harmful impacts on our environment. So, to minimize or reduce these harmful impacts we have to use formal disposing.
- 8) *Use LCD Rather than CRT Monitors:* The use of new technologies can play a vital role to reduce power consumption. LCD (Liquid Crystal Display) is the less power consumption device then CRT (Cathode Ray Tube). So, if we have to save our environment from the effect of CO₂ emission, we have to use LCDs rather than CRTs.

- 9) *Recycle Old Hardware Using Formal Techniques:* Recycling of computer hardware is manufacturing of new hardware devices using old one. Recycling using formal techniques is follow by various companies. It also consumes a lot of money but the main feature of formal recycling is to save our environment from pollution. So, we have to recycle our useless hardware using formal techniques.

VII. EFFECTIVE AND RESPONSIBLE DISPOSAL OF E-WASTE

Electronic waste or E-waste is nothing but the discarded electrical or electronic devices. Used electronics which are destined for reuse, resale, recycling or disposal are also considered as E-waste. In this chapter let us see how to properly dispose off the electronic waste by causing minimal harm to the environment and mankind.

- A. Donate or give away your electronic devices which are no longer in use to those who need it.
- B. Reusing is always better and should be preferred than recycling which can incur recycling manpower and costs.
- C. Dispose off your old or damaged electronic devices properly. Never burn them, since it can cause hazardous effects to the environment and human health.
- D. Get rid of your old and unused electronic devices by donating them to a certified E-recycler.
- E. Also remember that safety comes first while disposing off the old, damaged devices that cannot be used further. Never burn them or bury them.

VIII. CONCLUSION

Applying green computing techniques and methodologies are highly essential for the sustainability of the environment. The use of computers and other electronic devices affects our environment in several ways. Each stage of a computer's life starting from its production, throughout its use and till the time of its disposal causes environment problems. The increased number of computers and other electronic devices and their use as well as replacing these devices frequently impacts the environment highly and poses a major concern to the environment. Hence, there is an increasing pressure on the IT industry, businesses and individuals to make IT environmental friendly throughout its lifecycle, since it is our social and corporate responsibility to safeguard our environment. We have also discussed how can we develop a practice of Reusing, Reselling, Recycling and effectively disposing of the Electronic waste or E-waste generated by us. Thus, Green IT or Green Computing includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling.

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