

Green Computing: Save Our Environment from Computer and its Eco-friendly Devices

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Abstract— Computer is the basic need of everyone and everybody use computer for its own purpose but no one is aware about the injurious impact of the use of computer on our environment and its devices. The concept of green computing is about environmentally responsible and eco-friendly use of computers and there resources. Besides the extensive sensitively to ecological issues, energy, costs, such interest also seems from economic needs and electrical requirement of IT around the world show a continuously growing trend. In this paper, we will discuss how can save our environment by the comparative study of computing devices from the injurious impact of computer and Eco-friendly devices. The comparative study suggest that we can save generous amount of power, make environment green and while saving the cost.

Index Terms— Green IT; Green Computing; Eco-friendly Devices; Environment; Carbon Dioxide (CO₂); Solar Computing.

I. INTRODUCTION

The Green Computing, Green IT or ICT sustainability over the past few years, gaining popularity and their conceptual origin is almost two decades old [1]. It is the study and practice of environmentally sustainable computing or IT. San Murugesan notes that this can include manufacturing, designing, using and disposing of computers, server and associated subsystems such as monitor, printers, storage device, networking and communications systems-efficiently and effectively with minimal or no impact on the environment[2,15]. The goals of green computing are similar to green: reduce the use of hazardous materials, maximize energy efficiently during the products lifetime and promote the recyclability or bio-degradability of default product and factory waste. Many corporate IT departments have green computing initiatives to reduce the environment impact of their IT operations. Green ICT and its services presents opportunities to deliver low carbon footprints and mitigate carbon emission because of the unique ability to make energy consumption and green house gas emissions visible through its product and services. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities [3,4]. Green IT includes the dimensions of environment sustainability, the economics of energy efficient, and the cost of disposal and recycling [2]. It is important to understand

the need of the study of green computing. It is a tool by which global warming can be control and reduce. The global warming surface temperature increased by 0.74 ± 0.18 °C (1.33 ± 0.32 °F) during the 100 year ending in 2005. Most conspicuously, according to the latest IPCC report the global surface temperature will likely to rise a further 1.1 to 6.4 °C (2.0 to 11.5 °F) during the twenty-first century [1,3].

In 1992, the U.S environmental protection agency [EPA] launched energy star, a voluntary labeling program that is designed to promote and recognize energy efficiency in monitors, climate control equipment and other technologies [5,6]. This resulted in the widespread adoption of sleep mode among consumer's electronics. One of the first approaches towards green computing was sleep mode function in computers. Sleep mode function which place a computer place a computer on standby mode to a pre set period of time [7,8]. The whole green aspect came about quite a few year back when the news that the environment was not a renewable resources really hit home and people started realizing that they had to do their part to protect the environment. Basically, the efficient use of computers and computing is what green computing is all about the triple bottom line is what is important when it comes to anything green and the same goes for green computing [9,10]. This considers social responsibility, economic, viability and the impact on the environment.

Green computing aims to attain economic viability and improve the way computing devices are used. Green IT practices include the development of environmentally sustainable production practices, energy efficient computers and improved disposal and recycling procedures. To promote green computing concepts at all possible levels, the following four complementary approaches are employed:

- **Green use:** Minimizing the electricity consumption of computers and their peripheral devices and using them in an eco-friendly manner
- **Green disposal:** Re-purposing an existing computer or appropriately disposing of, or recycling, unwanted electronic equipment
- **Green design:** Designing energy-efficient computers, servers, printers, projectors and other digital devices
- **Green manufacturing:** Minimizing waste during the manufacturing of computers and other subsystems to reduce the environmental impact of these activities

The idea is to make the whole process surrounding computers friendlier to the environment, economy, and

society [11,12]. This means manufacture create computers in a way that reflects the triple bottom line positively.

This paper is organized as follows previously in section II discussed needs of green computing and in section III describes, the various technologies used to make green environment. We have several areas where researcher are putting lots of effort to make secure environment results is discussed in section IV and section V covering the five simple steps of green computing. A comparative study of computing devices is made in section VI and finally concluded the paper in section VII.

II. NEED OF GREEN COMPUTING

In IT department, it is observed that the people are unaware of the consequences of mishandling. It is observed that most of the computer energy is often wasteful. This is because we leave the computer ON even when it is not in use. The CPU and fan consume power; screen savers consume power even when the system is not in use. Insufficient power and cooling capacities can also results in loss of energy. It is observed that most of the data centers don't have sufficient cooling capacities. This results in environment pollution. This could be because of defects in Manufacturing techniques, packaging, disposal of computers and components. Another effect is because of toxicity. There are toxic chemicals used in the manufacturing of computers and components which can enter the food chain and water. According to one source, "Information Technology energy demand is growing twelve times faster than the overall demand for energy" and "Data centers emits over 150 metric tons of CO₂ per year, and the volume is increasing rapidly. (As a point of reference, a car produces eighteen pounds of CO₂ for every gallon of gasoline it uses.)" [13]. It is the need of the hour to educate people about the green use of ICT. In order to promote these ideas and create standards and regulations various organizations have been formed. Many technology companies actually belong several of these to further their goals of becoming more green. Some of these green organizations are:

1. The Green Grid is a global consortium of IT companies and professionals seeking to improve energy efficiency in data centers and business computing ecosystems around the globe." Board members of The Green Grid include AMD, EMC, Intel, APC, HP, Microsoft, Dell, IBM, and Oracle

[14].

2. The U.S. Environmental Agency is a government agency that was created to protect human health and to safeguard the natural environment. This agency also Created a joint program called Energy Star with the U.S. EPA and the U.S. Dept of Energy.[5,6] "The ENERGY STAR label was established to: Reduce greenhouse gas emissions and other pollutants caused by the inefficient use of energy; and Make it easy for consumers to from the view of a user in an organization.

III. TECHNOLOGIES OF GREEN COMPUTING

VIA Technologies, a Taiwanese company that manufacture motherboard chipsets, CPUs, and other computer hardware, introduced its initiative for "green computing" in 2001 with this green vision, the company has been focusing on power efficiency thought the design and manufacturing process of its products. Its environmentally friendly products are manufactured using a range of clean- computing stragies and the company is striving to educate markets on the benefits of green computing for the sake of the environment, as well as productivity and overall user experience.

A. Carbon-Free Computing

One of the VIA Technologies ideas is to reduce the "Carbon Footprint" of user- the amount of greenhouse gases produced, measured in units of carbon dioxide (CO₂). Green house gases naturally blanket the earth and are responsible for its more or less stable temperature. An increase in the concentration of the main green house. Carbon dioxide, Methane, Nitrous Oxide, and Fluorocarbons is believed to responsible for earth increasing temperature, which could lead to serve floods and droughts, rising sea levels, and other environmental effects, affecting both life and world economy. VIA aims to offers the world first "PC" products certified Carbons free, taking responsibility for the amount of CO₂ they emit. The Company works with environment expects to calculate the electricity used by the device over its lifetime generally three year. From this data, one can conclude how much carbon dioxide the device will emit into the atmosphere during its operation.

B. Solar Computing

Amid the international race toward alternative-energy sources, VIA is setting its eyes on the sun, and the company's Solar Computing initiative is a significant part of its green-computing projects. For that purpose, VIA partnered with Motech Industries, one of the largest producers of solar cells worldwide. A solar cell fit VIA's power-efficient silicon, platform, and system technologies and enable the company to develop fully solar-powered devices that are nonpolluting, silent, and highly reliable. Solar cells require very little maintenance throughout their lifetime, and once initial installation costs are covered, they provide energy at virtually no cost. Worldwide production of solar cells has increased rapidly over the last few years; and as more governments begin to recognize the benefits of solar power, and the development of photovoltaic technologies goes on, costs are expected to continue to decline. As part of VIA's —pc-11 initiative, the company established the first-ever solar-powered cyber community center in the South Pacific, powered entirely by solar technology.

C. Energy-Efficient Computing

A Central goal of VIA's green computing initiative is the development of energy-efficient platform for low-power small form factor (SFF) computing devices. In 2005, the company introduced the VIA C7-M and VIA C7 processors that have a maximum power consumption of 1W. These energy-efficient processors produced over four times less carbon during their operations and can be efficiently embedded in solar-powered devices. VIA is not the only company to address environmental concerns Intel is the world largest semiconductor maker, revealed eco-friendly product at recent conference in London. The company uses virtualization software, a technique that enables Intel to combine several physical systems into a virtual machine that runs on a single, power base system, thus significantly reducing power consumption. Earlier this year, Intel joined Google, Microsoft and other companies in the launch of the climate saves computing initiative that commits business to meet the environmental protection agency's energy star guidelines for energy-efficient devices.

IV. CREATING GREEN ENVIRONMENT

Green computing represent a responsible way to save lot of energy and secure our environment from the harmful impacts of computers and its devices. Computer are used everywhere and everybody use it for their convenience. But no one is aware about the harmful impacts of the use of computer on environment. The current trends of green computing are towards efficient utilization of resources. Energy is considered as the main resource and the carbon foot prints are considered the major threads to environment. Therefore, the emphasis is to reduce the energy utilization and carbon footprints and increase the performance of computing. There are several areas where researchers are putting lots of efforts to achieve secure environment results.

A. Energy Consumption

Organizations are realizing that the source and amount of their energy consumption significantly contributes to greenhouse gas emissions. In response to this finding, organizations are currently using the following equation:

Reduced greenhouse gas emissions =

Reduced energy consumption =

Reduced operational costs for the data center =
office hours and during the weekend and even around 90% of those computers are idle.

B. Virtualization

One of the main trends of green computing is virtualization of computer resources. Abstraction of computer resources, such as the running two or more logical computer systems on one set of physical hardware is called virtualization. Virtualization is a trend of green computing it offers virtualization software as well as management software for virtualization environment [12]. One of the best ways to go towards green and save enough space, enough resources and the environment is by streamlining efficiency with virtualization. This form of green computing will lead to serves consolidation and enhance computer security [16]. Virtualization allows full utilization of computer resources and benefit in reduction of total amount of hardware, power off idle virtual server to save resources and energy, reduction in total space, air and rent requirements ultimately reduces the cost.

C. IT products and Eco- Labeling

Another approach to promote green computing and save environment is to introduce polices all around the world, so that companies design products to receive the eco-label [17]. There are several organizations in the world which support "Eco-Label" IT products. These organizations provide certificates to IT products based on factors including design for recycling, recycling system, noise energy consumption etc [18].

V. FIVE STEPS TO GREEN COMPUTING

There are five steps you can take toward a green computing strategy:-

A. Develop a sustainable green computing plan

Discuss with your business leaders the elements that should be factored into such a plan, including organizational policies and checklists. Such a plan should include recycling policies, recommendations for disposal of used equipment, government guidelines and recommendations for purchasing green computer equipment. Green computing best practices and policies should cover power usage, reduction of paper consumption, as well as recommendations for new equipment and recycling old machines. Organizational policies should include communication and implementation.

B. Recycle

It means adopting fewer and more energy efficient systems while re factoring application environment to make optimal use of physical resources is the best architectural model. According to environmental protection agency in around 30% to 40% of personal computers are kept 'ON' after Discard used or unwanted electronic equipment in a

convenient and environmentally responsible manner. Computers have toxin metals and pollutants that can emit harmful emissions into the environment. Never discard computers in a landfill. Recycle them instead through manufacturer programs such as HP's Planet Partners recycling service or recycling facilities in your community. Or donate still-working computers to a non-profit agency.

C. Make environmentally sound purchase decisions

Purchase Electronic Product Environmental Assessment Tool registered products. EPEAT is a procurement tool promoted by the nonprofit Green Electronics Council to:

- Help institutional purchasers evaluate, compare and select desktop computers, notebooks and monitors based on environmental attributes

- Provide a clear, consistent set of performance criteria for the design of products

- Recognize manufacturer efforts to reduce the environmental impact of products by reducing or eliminating environmentally sensitive materials, designing for longevity and reducing packaging materials All EPEAT-registered products must meet minimum requirements in eight areas of environmental impact and be energy efficient to reduce emissions of climate-changing greenhouse gases. To demonstrate corporate social and environmental performance, manufacturers must offer safe end-of-life management and recycling options when products become unusable. "Developing environmentally sound products has long been a priority for HP's design and engineering teams," says Jeri Callaway, vice president and general manager, Americas Commercial Solutions, Personal Systems Group, HP. "We're particularly proud that our business-class products already meet, and in some cases exceed, the basic EPEAT standards without any alteration to their existing design."

D. Reduce Paper Consumption

There are many easy, obvious ways to reduce paper consumption: e-mail, electronic archiving, use the "track changes" feature in electronic documents, rather than redline corrections on paper. When you do print out documents, make sure to use both sides of the paper, recycle regularly, use smaller fonts and margins, and selectively print required pages.

E. Conserve energy

Turn off your computer when you know you won't use it for an extended period of time. Turn on power management features during shorter periods of inactivity. Power management allows monitors and computers to enter

low-power states when sitting idle. By simply hitting the keyboard or moving the mouse, the computer or monitors awakens from its low power sleep mode in seconds. Power management tactics can save energy and help protect the environment.

VI. COMPARATIVE STUDY OF COMPUTING DEVICES

A. Mobile vs. computer

Mobile phones are better than computers- green computing generally computers are used for surfing internet, chat, gaming, social networking, downloading, desktop computing including documents, spreadsheets or presentation making or just watching your photos and videos. Today's mobile phones are capable of doing it all, rather sometimes more than the traditional phones [5-9]. They have faster processors, more Ram, faster wireless internet connectivity and larger memories. Mobile phones consume very low power.

B. LCD Vs. CRT Monitor

The use of new technologies can play a vital role to reduced power consumption. Liquid crystal display (LCD) is the less power consumption device then Cathode ray tube (CRT) monitor. So if we have to save our environment from the effect of CO₂ emission we have to use LCDs rather than CRTs.

C. Laptop vs. Desktop

Desktop PCs are great for a home or office computer, but they use up to six times more energy than a laptop. By using appropriate power management settings on a desktop, you will save energy, but not nearly the amount you would save by using a laptop. Laptop computers are designed to use much less energy than desktop computers - as much as 80% less. And, of course, there is one extra perk - laptops are portable. Many laptops can be hooked up to a separate full-size monitor and keyboard for use at home or in the office [11].

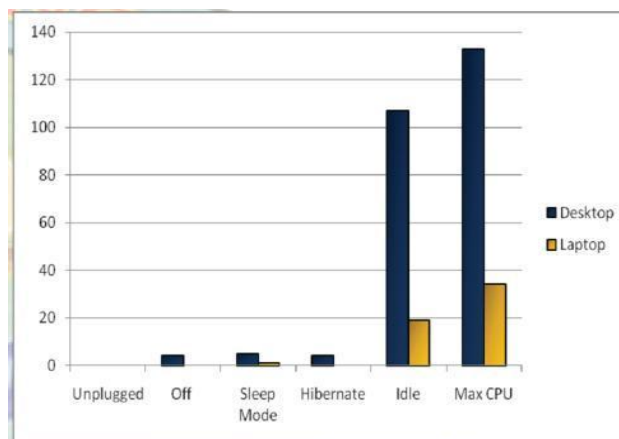


Figure: 1 Desktop and Laptop Power Consumption (Watts)

D. Laser Jet vs. Ink Jet Printer

Laser jet printers offer speed and superior quality but consider getting a high-end ink jet printer, which costs a lot less and consumes 90% less energy. Ink jet printers cannot compete with lasers when it comes to speed, but the print quality is quite good on newer models. Ink jet printer print well on used paper, so you can print drafts on the back side of old work. Colour copies are more affordable with ink jets, Choose a printer with a duplexing mode, which prints on both sides of the paper. If you do purchase a laser printer, you can cut energy use substantially by getting a slower one. And, turn the printer off when it's not in use - laser printers draw about 1/3 of their energy when they are on standby [13, 14] [Green Computing- Embrace a Secure Future]

VII. CONCLUSION

In this paper we have discussed the way to save energy and help protect the environment for example:-Turn off your computer when you don't want uses it for an extended period of time. Turn on power management features during shorter periods of inactivity. Power management allows monitors and computers to enter low-power states when sitting idle. By simply hitting the keyboard or moving the mouse, the computers or monitors awakens from its low power sleep mode in seconds. Power management tactics can save energy and help protect the environment. We have also discussed eco-friendly devices- mobile and computer we got a result, mobile is better than computer because it's saving lots of power than computer. The comparison of LCD and CRT monitors, LCD has better result from the CRT monitor because it is less power consumption device with comparable cost. Similar, Laptops are using much lesser energy than desktop P.C. The present study is carried out for further research developing ideas for save lots of energy and cost with the help of this study we can protect our environment.

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