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Green Computing

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***Abstract*— Green computing is the study and practice of using computing resources efficiently. The goals are similar to green chemistry; that is reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. Taking into consideration the popular use of information technology industry, it has to lead a revolution of sorts by turning green in a manner no industry has ever done before. It is worth emphasizing that this green technology should not be just about sound bytes to impress activists but concrete action and organizational policy. Opportunities lie in green technology like never before in history and organizations are seeing it as a way to create new profit centers while trying to help the environmental cause. The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings.[3]**

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I. INTRODUCTION

"Greening" your computing equipment is a low-risk way for your business to not only help the environment but also reduce costs. It's also one of the largest growing trends in business today. Green computing is the practice of using computing resources efficiently. The goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. Such practices include the implementation of energy-efficient central processing units (CPUs), servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste). [2]

II.LITERATURE SURVEY

2.1 **.** How to Create a Green Machine

Activating the power management features on your computer saves energy and money while helping the environment. Your computer's SLEEP and HIBERNATE settings are two of the most effective ways for you to make your computer more environmentally friendly. You can activate these functions manually or through your operating system's pre-set power management settings.

II.1 **Sleep Mode**

Sleep or standby mode conserves energy by cutting off power to your display, hard drive, and peripherals. After a pre-set period of inactivity, your computer switches to a low power state. When you move your mouse or press any computer key, you exit sleep mode and your computer takes you back to its previous operating state. Sleep mode is an especially effective way to conserve battery power in a laptop computer. However, if your computer loses power for any reason while in sleep mode, you may lose unsaved work.

II.2 **Hibernate Mode**

Hibernate mode saves energy and protects your work by copying system data to a reserved area on your hard drive and then completely turning off your computer. It also reduces wear and tear on your components. When you turn power back on, your files and your documents appear on your desktop just as you left them. Be sure to set your system to automatically go into hibernate mode any time your battery power reaches a critically low level.[4]

III. THE IMPACT OF GREEN COMPUTING IN THE INDUSTRY

The industry is the major consumer of the computing devices. The industry relies too heavily with computing devices in their industrial activities. When the computing industry becomes incapable in sustaining the industrial needs in computers and other computing devices, the global market and industry shall surely suffer. Since the resources in computing industry is losing control in the use of the computing resources, the experts in the field have thought about how they can combat the continuing saga in battling the problem of scarcity in computing resources. This movement led to the development of the Green Computing practice. This Green Computing study reveals that there is a way that can suppress the worsening problem about misuse and abuse in the use of the computing resources. Some of the formidable methods that can help a company save resources include the following green computing tips

III.1 **Virtualization**.
Virtualization is a technology that can help you save both hardware and software resources by creating a "similar environment" like an operating system or a peripheral device using your present resources. When the need for that virtualized application is over, then you can put back your original resource into its original state.

III.2 **Power Management**.
The life of your physical devices relies on how effective and efficient you manage them. One of the classic examples is the efficient use of the portable system battery. By using the power management feature of your system, you can actually disable some features of your system that consumes too much battery usage. Not only will this save electric charging fee but also saving your battery from easily being worn out.[5]

IV . WHY GO GREEN?

Green computing is a very hot topic these days, not only because of rising energy costs and potential savings, but also due to the impact on the environment. Energy to manufacture, store, operate, and cool computing systems has grown significantly in the recent years, primarily due to the volume of systems and computing that companies now heavily rely upon. Computing power consumption of companies has reached a critical point.

For example, an Ecommerce business with 100,000 servers can easily spend up to $20 million a year on server power. Add another $10 million for a/c cooling and it tops $30 million a year in power alone. Clearly there is a huge potential for savings in their infrastructure. Despite the huge surge in computing power demands, there are many existing technologies and methods by which significant savings can be made. This series is dedicated to the ways a typical organization can reduce their energy footprint while maintaining required levels of computing performance.
So why should a company promote green, or energy efficient computing?
Climate Change: First and foremost, conclusive research shows that CO2 and other emissions are causing global climate and environmental damage. Preserving the planet is a valid goal because it aims to preserve life. Planets like ours, that supports life, are very rare.
Savings: Green computing can lead to serious cost savings over time. Reductions in energy costs from servers, cooling, and lighting are generating serious savings for many corporations.
Reliability of Power: As energy demands in the world go up, energy supply is declining or flat. Energy efficient systems helps ensure healthy power systems. Also, more companies are generating more of their own electricity, which further motivates them to keep power consumption low.[6]

V. ANALYSIS & DESIGN

EPEAT (Electronic Products Environmental Assessment Tool) -registered computer products have reduced levels of cadmium, lead, and mercury to better protect human health, and are easier to upgrade and recycle, in addition to meeting the government's Energy Star guidelines for energy efficiency. By buying EPEAT registered products purchasers are significantly contributing to reducing the environmental impacts of their computers.

NComputing—an architecture that changes the green equation
NComputing systems are a major leap forward in green computing. More than15, 000 organizations in over 80 countries have used NComputing to slash their carbon footprint and electric consumption.
The NComputing virtualization software works on a standard Windows or Linux PC. Each user's monitor, keyboard, and mouse connect to the shared PC through a small and durable NComputing access device.
The device itself has no CPU, memory, or moving parts—so it is easy to deploy and maintain. It also consumes very little power. [9]

Figure No.1: Share 1 PC with up to 30 users with NComputing virtual desktops

The Battery Life Challenge: Balancing Performance and Power

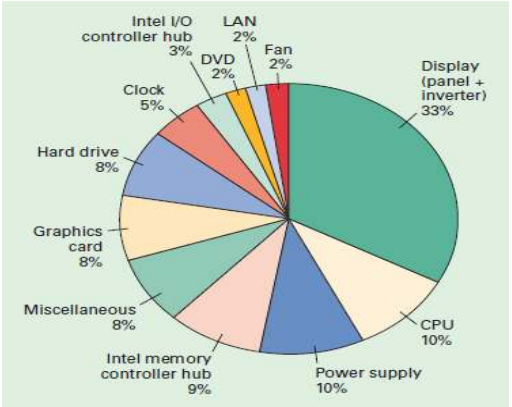

Figure No. 2: Where does your power go? This chart shows power Consumption in an average laptop

Three Costly Computer Myths

You should never turn off your computer.

Your computer is designed to handle 40,000 on/off cycles. If you are an average user, that's significantly more cycles than you will initiate in the computer's five to seven-year-life. When you turn your computer off, you not only reduce energy use, you also lower heat stress and wear on the system.

Turning your computer off and then back on uses more energy than leaving it on.

The surge of power used by a CPU to boot up is far less than the energy your computer uses when left on for more than three minutes.

Screen savers save energy.

This is a common misconception. Screen savers were originally designed to help prolong the life of monochrome monitors. Those monitors are now technologically obsolete. Screen savers save energy only if they actually turn off the screen or, with laptops, turn off the backlight.[4]

V.1 EPA Article by Enesta Jones:

Numerous environmental benefits of buying high-performance, environmentally friendly computer equipment are highlighted in the first annual report issued by the Green Electronics Council. The report, called "*The Environmental Benefits of the Purchase or Sale of EPEAT Registered Products in 2006,"* states that the purchase of more than 36 million EPA approved computer desktops, laptops and monitors has led to a significant reduction in greenhouse gas emissions. Some highlights from the report show that the computer equipment has helped to:

- Save 13.7 billion kWh of electricity, enough to power 1.2 million U.S. homes for a year;
- Save 24.4 million metric tons of primary materials, equivalent to the weight of 189 million refrigerators;
- Prevent 56.5 million metric tons of air emissions (including greenhouse gas emissions);
- Prevent 1.07 million metric tons of carbon equivalent greenhouse gas emissions, equivalent to removing 852,000 cars from the road for a year;
- Prevent 118,000 metric tons of water pollutant emissions;
- Reduce the amount of toxic materials used by 1,070 metric tons, equivalent to the weight of 534,000 bricks, including enough mercury to fill 157,000 household fever thermometers; and
- Avoid the disposal of 41,100 metric tons of hazardous waste, equivalent to the weight of 20.5 million bricks.[1]

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VI. IMPLEMENTATION

Ways to Implement Green computing

- Use of toxic materials like lead can be replaced by silver and copper.
- Making recycling of computers (which is expensive and time consuming at present) more effective by recycling computer parts separately with an option of reuse or resale.
- Future computers could knock 10 percent off their energy use just by replacing hard drives with solid-state,state, or flash, memory, which has no watt-hungry moving parts.
- Buy and use a low power desktop or a laptop computer (40-90 watts) rather a higher power desktop (e.g. 300 watts)
- Find out the normal operating power (watts) required.
- The maximum power supply (up to 1kW in some modern gaming PCs) is not as important as the normal operating power, but note that power supply efficiency generally peaks at about 50-75% load.
- Idle state represents 69 to 97% of total annual energy use, even if power management is enabled.
- Computer power supplies are generally about 75% efficient; to produce 75W of DC output they require 100 W of AC input and dissipate the remaining 25 W in heat.
- Higher-quality power supplies can be over 80% efficient; higher energy efficiency uses less power directly, and requires less power to cool as well. As of 2007, 93% efficient power supplies are available.
- Thin clients can use only 4 to 8 watts of power at the desktop as the processing is done by a server.
- For desktops, buy a low power central processing unit (CPU). This reduces botpower consumption and cooling requirements.
- Buy hardware from manufacturers that have a hardware recycling scheme, and recycle your old computer equipment rather than sending it to.
- Turn your computer and monitor off when you are not using it.
- Enable hibernation using the power management settings. Standby does not save as much power.
- Replace your CRT screen with an LCD screen.[7]

VII. SAVE OUR ENVIRONMENT

"Save the Planet, Save Your Equipment, Save Money"

- **10 Tips for Green Computer Use**

1) Turn off your computer at night so it runs only eight hours a day—you'll reduce your energy use by 810 kWh per year and net a 67 percent annual savings.
2) Plug your computer into a surge protector with a master control outlet, which automatically senses when the computer is not in use and cuts power to it and all your peripherals.
3) Purchase flat-screen monitors—they use significantly less energy and are not as hard on your eyes as CRTs.
4) Purchase an Energy Star–compliant computer. Note that laptop models use much less energy than desktop units.
5) Plan your computer-related activities so you can do them all at once, keeping the computer off at other times.
6) Consider a smaller monitor—a 14-inch display uses 40 percent less energy than a 17-inch one.
7) Enable the standby/sleep mode and power management settings on your computer.
8) Forgo the screen saver—it doesn't save energy or your screen unless you're using an old monochrome monitor.
9) Power off your monitor when you are not using it instead of using screen savers.
10) Review document drafts and e-mails on screen instead of printing them out.[8]

VII.1 How to Recognize a Green Machine

We can easily recognize a green machine by observing an Energy Star label.

ENERGY STAR® is the international symbol for energy efficiency–a simple way for consumers to identify products that are among the top energy performers on the market.

Products bearing the ENERGY STAR symbol help-

- Save energy
- Save money
- Protect our environment

VIII.CONCLUSION

So far, consumers haven't cared about ecological impact when buying computers, they've cared only about speed and price. But computers commoditize, consumers will become pickier about being green. Devices use less and less power while renewable energy gets more and more portable and effective. New green materials are developed every year, and many toxic ones are already being replaced by them. The greenest computer will not miraculously fall from the sky one day, it will be the product of years of improvements. The features of a green computer of tomorrow would be like: efficiency, manufacturing & materials, recyclability, service model, self-powering, and other trends. Green computer will be one of the major contributions which will break down the 'digital divide', the electronic gulf that separates the information rich from the information poor.

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