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Green computing: The new eco way

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Abstract: *Computers are ubiquitous in education,offices, business,communication,and shopping and data storage.They have revolutionized our lives across all dimensions saving our time and effort to do work but these tremendous benefits is not proceeding without issue.It is daunting to see how the widespread use of computers is profoundly affecting our health,depleting our natural resources and polluting our environment.The concept of green computing hence becomes extremely relevant and significant in the present computer age. Green Computing refers to the environmentally sustainable use of computers and related resources right from the stage ofmanufacture,through delivery, use, maintenance, recycling and disposal.The goal of green computing is to design such systems which features reduced use of hazardous material,are energy efficient during the products lifetime and whose defunct products and factory waste can be recycledthus reducing pollution footprint.Such systems will haveno or minimum effect on environment. This paper offers an insight into what green computing is,its origin, its need and implementation, IT companies initiatives towards green computing, examines the awareness of IT usersof four diverse organizations about green technology through a case study/comparative analysis,the findings of this study and finallytheconclusion.*

Keywords: *Eco-friendly,Energy-efficient,Energy Star,Green IT, Recycling*

I. INTRODUCTION

Green computing is a concept whose focus is on using computing or IT resources in aneffective, energy-efficient and environmentally friendly manner.The main aim of Green Computing or Green IT is to promotesound environmentally sustainable practices in the use of computers and associated resources and to adopt Green IT products, applications and services that have minimal or no impact on environment.

The endeavor of Green technology is to produce power- efficient computers built from eco-friendly material, features less heat generation and produces minimal carbon footprint. It also strives to promote re-purposing and recyclability of computers and related equipment and proper disposal of electronic waste in order to reduce its impact on environment. Since global warming is a critical issue andthe major factor contributing to it is the man made gas emissions, there is a need to ensure an eco-friendly setup and usage of IT practices at all possible levels.

The purpose of this paper is to highlight the lack of adequate awareness about green computing among professionals, and stress the pressing need for effective implementation of green computing practices.The paper aims to make a contribution towards green computing initiativesthrough greater awareness and large-scale adoption. The underlying message is: We should make a conscious effort to go green to reduce energy usage, which also reduces carbon dioxide emissions and energy bill.

II. HISTORY OF GREEN COMPUTING

The recent concerns regarding global climate change coupled with rising energy crisis has led to renewed interest in Green Computing,though the first exposition of the concept of green computing traces back to 1992 when the Environmental Protection Agency,United States, launched the Energy Starprogram It served as a sort of voluntary label awarded to energy-efficient computing products. Energy Star standard applies to products like computer monitors, television sets and temperature control devices like refrigerators, air conditioners, and similar products. Energy Starminimizes energy consumption of a product by automatically switching it into Sleep mode –a power conservation modewhen the product is not in use for a short period of time or reducing the power to a product when in "Standby" mode. As the concept developed, green computing began to encompass thin client solutions, energy cost accounting, virtualization practices, e-waste, etc. The term 'green computing' was probably contrived soon after the Energy Star program began.Around the same time was launched the TCO Certification program by TCO Development –a Swedish organizationto promote the release of low magnetic and electric than CRT-based computer display, the program was later expanded to include criteria on energy consumption, ergonomics, andthe use of hazardous materials in construction.

III. NEED OF GREEN COMPUTING

Green computing has proven itself to be the most concerning issue for the businesses and governments around the globe as computing became a major utility across the world. "Green computing or green IT is the practice and study of environmentally sustainable computing."In other words, green computing is the practice of reducing environmental footprints of technology by efficiently using the resources.

3.1 Why Green Computing?

3.1.1 Green Use – Using resources in such a way that reduces the usage of hazardous materials.
3.1.2 Green Design – Designing objects and services that support the environment rather than degrading it.
3.1.3 Green Disposal – Disposal of waste in ways which ham the environment in least possible way.
3.1.4 Green Manufacturing – The discovery and development of new products/alloys/elementswhich reduce oreliminate the generation of environment=degrading substances in manufacturing.

3.2 How Green Computing?

3.2.1Energy Efficient Data Centre Design

` The energy efficient data centre design includes air management, heat recovery and electrical configuration of data centre in such a way that reduces the energy consumption to a great level. Modern data centre design also includes on-site electricity generation and waste heat recycling. Google has been in the forefront of this energy conserving data centre design.

3.2.2Use of Energy Star labeledproducts

Energy star labels indicate the energy efficiency of various appliances which are used in computing. The greater number of stars makes a better and efficient system with lesser problems to environment.

3.2.3 Basic Computer Ethics

3.2.3.1 Enable PC power management feature in your operating system.
3.2.3.2 Turn off your computer when not in use.
3.2.3.3 Screen saver doesn't save energy. So avoid screen saver and turn off your monitor.
3.2.3.4 Use LED monitors over LCD.
3.2.3.5 Use sleep mode whenever you leave the PC on.
3.2.3.6 Always use the 80 plus certified power supply units for your computer.

3.2.4 e-waste Recycling

Instead of throwing away different components of a computing system, it's alwaysbetter to recycle/reuse them. If the reuse/recycle is not up to the mark in your organization, it would be better to make use of private recycling companies to help the cause.

3.2.4 Telecommunication

Awork arrangement in which people work from home, making use of the internet, telephone and email. These technologies offer many advantages such as reduction of greenhouse gas emissions related to travel, more work satisfaction and lower costs for office space, heat and lighting. In turn, the carbon footprint of "working from home" employees is drastically reduced.

IV. EARLY ADOPTERS OF GREEN COMPUTING

Some major companies which have been working hard to keep computing/technology green in manufacturing/service process are:

4.1 Yahoo[1]

4.1.1 Implementation

Yahoo is one of the companies which went with a newgreen data-centre design inspired by the simple air-flow approach of a chicken coop.

The design of the building consisted of a prefab metal structure measuring 60 feet by 120 feet with louvered vents in the walls that let the wind blow through. Data centre sites can be expanded by adding more prefab units whenever the need arises. The vents are adjustable to catch the winds.

4.1.2 Results

With a reported Power Usage Effectiveness(PUE) of 1.08, Yahoo says that this approach uses 40% less energy and 95% less water than the average data centre (although it doesn't give a direct comparison to the PUE of its own, older data centre).

4.2Verizon Wireless

4.2.1 Implementation

In 2009 Verizon looked at how much energy its network equipment used and decided to do something about it. The company told its equipment suppliers to reduce energy consumption by 20%. Some of them complied.

With that success, Verizon Wireless decided to increase the efficiency of its data centre as well. It needed to expand its facility in Twinsburg, Ohio, and wanted to do it quickly. So it built a new 140,000 sq. ft. facility that includes 50,000 sq. ft. of data centre area using a modular design.

Greater focus is on water efficiency. The data centre uses warm water cooling for the servers and the heat generated by servers is used to warm the building and melt snow around the facility in winter.

Rainwater is collected, cleaned and re-used in the facility.The melted snow due to the heat generated from the servers is used across the facility including the lavatories.

4.2.2Results

Verizon Wireless says the facility uses 20% less water. Although the company rates its data centre PUE at just 1.47, it says that it also consumes 20% less energy per year than the industry average for a comparably-sized data centre and was also felicitated by US Green Building Council, with LEED Gold Certification for energy efficient design.

4.3 Apple [2]

4.3.1 Implementation

Apple is close to its goal of powering all its facilities 100 percent by renewable energy. Apple's large number of corporate campuses and data centers is now at 94 percent renewable and rising. (In 2010 it was 35 percent.) The next step is to extend the efforts to its retail stores. In addition to its own data centers Apple has servers in "co-location" facilities, some of which dishes out dirty energy.

Its Newark, California, data center largely draws its power from wind along-with Apple's Prineville, Oregon, data center. However, Prineville date centre plans to switch to mainly hydroelectric power, using an innovative plan that draws power from water temporarily diverted from irrigation canals.

4.3.2 Results

One of the cleanest tech companies in the world, Apple is once again pioneering an effort which in few years will deliver it amazing profits and recognition.

V. CASE STUDY

5.1 Objectives

5.1.1 To measure the level of awareness of green computing.
5.1.2 To compare green computing awareness among various sectors/professionals.
5.1.3 To suggest some strategies for sustainable development.

5.2 Methodology

5.2.1 Study

Research is the systematic process of collecting and analyzing information (data) in order to increase our understanding of the phenomenon about which we are concerned or interested.[3]The purpose of research is to discover answers to intellectual and practical problems through the application of scientific method.

5.2.2 Data Collection Tools

This study is based majorly on the primary data that has been collected from the field source. The primary data has been collected through filling questionnaires by the computer users. The data is collected from four diverse sectors namely a leading newspaper organization, a private bank,an educational institution and a

private companyThe findings of the study are based on the comparative analysis of the data obtained from these sources.

5.3Comparative Analysis

Q.No	Question	Newspaper	Bank	Company	Educational Institute
1	What is the count of the total computers in the organization?	415	08	11	135
2	What is the count of computers based on monitor category(CRT,LCD,LED monitors)?	400-LCD 5-LED 10-CRT	8-LCD	7-LED 3-LCD 1-CRT	105-LCD 30-CRT
3	How many computers have Energy star logo and how many have TCO certification?	125 with Energy Star & none with TCO	No	7with Energy Star Logo; can't find TCO	None
4	Are the professionals aware of and use the energy-saving modes of computer when it's not in use(Sleep mode,screen saver,standby mode,hibernate mode etc.)?	Yes	Yes	Yes	Yes
5	How many computers have been disposed of in the last five years(2010-2015)?	Approx. 250 CRTs	None	6	Approx. 30-35
6	Which method of disposing e-waste was adopted by the organization?	Wholesale Vendors	NA	Resold to the vendor for recycling	Resold to the vendor for recycling
7	Are the professionals aware that the computer components are made of toxic metals?	No	Yes	Yes	Yes
8	Have the professionals heard aboutGreen computing/Green Technology?	No	No	Only 4 of them	No
9	Are the professionals aware about the Energy star and TCO certification program?	About Energy Star-Yes, About TCO-No	No	About Energy Star-Yes, About TCO-No	About Energy Star-Yes, About TCO-No
10	List the initiatives taken or any campaign done by the organization to aware the professionals about green computing in the last five years(2010-2015)?	None	NA	Weekly surprise checks to see whether systems when not in use have been put to sleep or not	None

5.4 Findings

5.4.1 From the comparative analysis,it has been observed that the professionals are currently using their PCs' power management capabilities, such as sleep and hibernate mode, to save power when they're not actively using the systems. However, some basic practice gaps still exist.

5.4.2 Professionals are not aware of the term 'Green computing',leaves aside its implementation.

5.4.3 No initiative/campaign has been organized by the respective organizations to arouse awareness about Green IT.

5.4.4 The results show that the professionals in these sectors are aware of the Energy star but not of TCOcertification program.

5.4.5 Sample size may not adequately represent the whole market.

VI. CONCLUSION

The enormous increase in the breadth of application of computers and consequently mushrooming growth of IT industry poses a grave threat to the environment.Green IT or green computing is a practice that can address the problem of global warming, reduce carbon footprints,conserve natural resources and reduce energy and paper costs.Green computing though a rage is still an unknown concept with professionals as is evident from the case study results.The paper clearly brings out the fact that only a consciouseffort and commitment of the individuals,corporate and government can helparouse awareness and enable them to employ green computing solutions.Moreover,only after the technology components are employed over an extended time-frame, significant greenbacks can be expected.It is our social,ethical and moral dutyto adopt green computing strategies to create a more sustainable environment and to assist in building a green society and economy.

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