ISSN 2630-0540
Journal of Technology and Innovation in Tertiary Education, Vol.2, No.1, pp. 11-16, January-June 2019

doi:

Green Computing–New Perspective of Efficient Usage of Energy and Reduction of E-Waste

Gaurav Sengupta
Department of Aviation Maintenance
Siam Technology College, Bangkok, Thailand
Email: gaurav_sengupta@hotmail.com

Abstract

The pressure of computing has been based on quicker analysis, calculations and solving of more complex problems at a higher speed. However, presently there is a huge demand of reducing e-waste and usage of non-toxic materials in making e-equipment (Sivaharan, Blair & Coulson, 2005). Globally, leaders are adopting many principles toward this aspect. Now it is the time for the end user community to follow some rules of thumb to achieve partly the benefit of "Green Computing." Essentially, *green computing* is all about the efficient use of computers and computing. This ruminates responsibility toward the society, environmental impact and economic liveliness. As for scientists, they are carrying various studies to decrease the negative impact of usage of computer technology affecting our resources of the nature and creating environmental hazards. The aim of this academic paper is to examine manufacturing of computers with non-hazardous particles so as to make computers from the start to completion, into green products.

Keywords: *Green computing, e-waste, energy saving, computer virtualization, bioplastics, landfills*

1. Introduction

The practice of using computing resources in a cost-effective manner is called "green computing." The concept of green computing is to decrease the use of toxic materials, increase energy efficiency during the life-cycle of a product, and promote recyclability and biodegradability of defunct products and factory waste. Such practices include the implementation of CPU, servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (Dhir, 2012; Roy & Bag, 2013).

2. Concerns

In recent times, computers have advanced a lot but it takes immense energy to manufacture, store, pack and shift them. Traditionally, manufacturers use toxic metals like cadmium, lead, and mercury to make computers. It is estimated that computers and other electronics make up two-fifths of all lead in landfills (Roy & Bag, 2013).

To overcome this increasing threat of pollution worldwide because of the increasing utilization of electronic equipment and computers in particular, there is a demand to look for an eco-friendly computer. Advanced processors use more power, and for that reason they produce more heat from their waste which expands temperature for which cooling and aerating them are important, particularly in server ranches--between the PCs and the HVAC.

The excess heat develops severe quality issues, as CPUs crash more frequently increased temperatures (Roy & Bag, 2013). To keep servers at the optimum temperature, organizations need aerating and cooling types of gear. The more powerful a machine is, the cooler air is expected to shield it from excess heating.

3. Literature Review

The researcher covered six areas as follows:

3.1 Green Computing:

Green computing is an environment friendly mode to administer information and communication technologies. It facilitates institutions to advance environmental control by increasing power capability, bettering information management and handling over accurate rational ability (Binder & Suri, 2009; Kimbahune, Deshpande & Mahalle, 2015).

San Murugesan (2008) notes that green computing is the learning and implementation of fabricating, creating, using, and throwing off of servers, computers and associated subsystems—such as printers, monitors, devices of storage, and networking and communications systems — accurately and effectively with very less or nil impact on the nature (Murugesan, 2008; Dhir, 2012).

3.2 E-Waste

Electronic waste (e-Waste) is defined as white goods, both customers and organizational electronics, and hardware related to information technology which is at the end of its life cycle after being used completely (Roy & Bag, 2013).

On the other hand, Sinha-Khetriwal (2002) says that “e-waste can be called as any appliance based on electrical power that has reached its end-of-life” (Sinha-Khetriwal, 2002).

Puckett et al. (2002) define e-waste as a wide and increasing range of equipment of electronics starting from big household equipment like air conditioners, fridges, cell phones, personal stereos, and electronic devices to computers which have been thrown away by their users (Puckett, Byster & Westervelt, 2002).

3.3 Energy saving and future computers:

Computers were gradually designed, year after year, to use less energy and give the maximum output (Rohini & Sundarkumar, 2014; Liu et al., 2010).

3.4 Virtualization:

Virtualization is a great process to decrease consumption of data center power. In virtualization, a physical server supports many virtual servers. Virtualization helps data centers to build strong their physical server infrastructure by adding many virtual servers on a lesser number of increasingly powerful servers, utilizing little power and easing the data center (Malviva &Singh 2013).

3.5 Bioplastics:

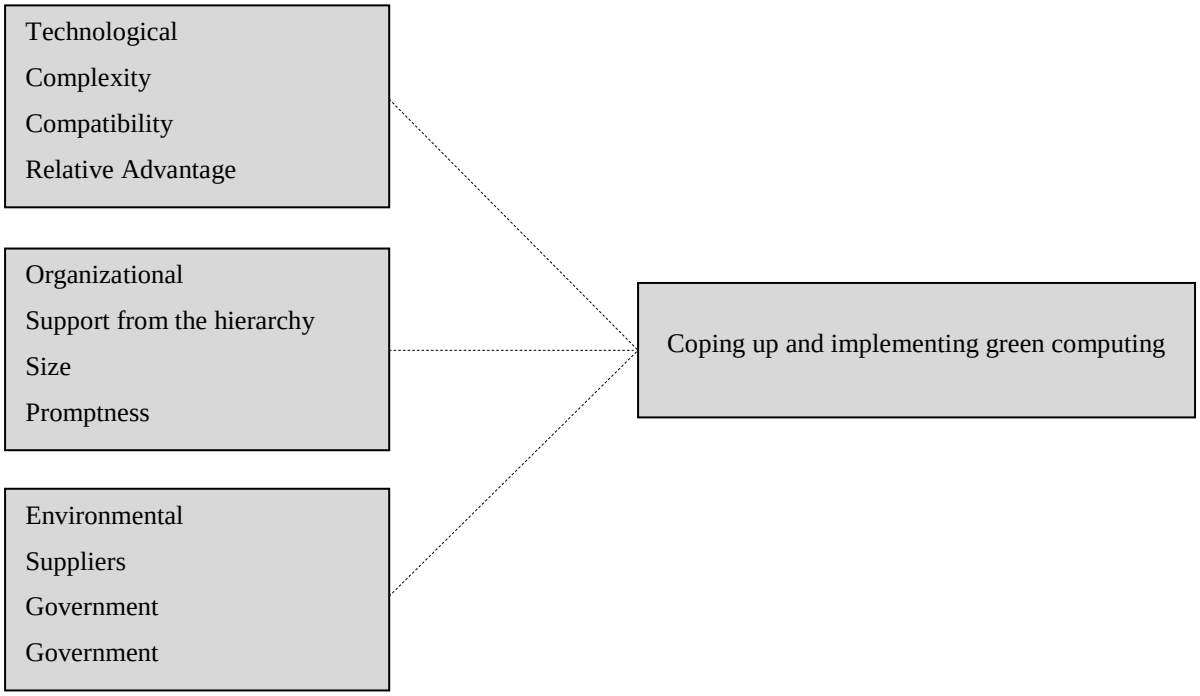
A bioplastic is a plastic that is manufactured partially or fully from polymers originating from natural sources such as sugar potato starch, sugarcane, straws, and cotton or tree cellulose. They consist of a wide range of materials with various characteristics and applications (Bioplastics facts and figures, 2019).

3.6 Landfill

Often, waste materials disintegrate in landfills and emit biogas with approximately 55% Methane gas and 45% Carbon Dioxide. This gas is known as LFG (Bhide, 1994).

4. Conceptual Framework

The conceptual framework of Green Computing is shown below:



5. Green Computing Procedure

The researcher took into account work habits of computer users and businesses using computers and its parts, and considered "Green Computing" modification to minimize their adverse impact on the global environment.

Here are some steps considered to be taken:

1. Virtualization: It is an extraordinary e-apparatus for users and eco-friendly processing where all the servers are segregated into numerous virtual machines that execute vivid functions. Along these fields, organizations can build the rate of utilization of servers.

2. Extra-efficient processors are another vital aspect of saving energy, as Sun Microsystems, Intel, Advanced Micro Devices; all have started following the green perception.

3. The sleep mode must be set by the power options for computers when they are not executing any task.

4. It is economical to do computer-related tasks during contiguous, intensive blocks of time, leaving hardware off at other times.

5. Level board screens utilize less power than customary CRT screens. By-passing the utilization of screen savers add to vitality investment funds by enabling a screen to enter in remain by mode.

6. Dissimilar to hard circle drives; strong state drives store information in streak memory or DRAM (Gary, 2002).

7. Print just what we need and utilization of reused content paper at whatever point conceivable, is another great practice. Nowadays, we have printers which enable two-sided, and cascaded styles of printing (Srivastava, 2005).

8. It is vital to make PCs which can be fueled with low power obtained from nonconventional energy sources, like sun-based energy, and accelerating a bicycle.

9. Energy effective usage display includes sharing desktop software, terminal sharing, and reuse of old video cards.

10. Information Technology Vendors:
    IT vendors also are implementing different green standards to their mode of operations resulting from worries of customers leaving and new scope of earning revenues and exhibiting corporate social responsibility.

11. Eco Friendly Approach**:**
    Electronics manufacturers are carrying out eco-friendly approaches that focus on minimizing e-waste materials like PVC, Cadmium, Lead, and Bromine induced flame inhibitors that are used to make computers. This can be done by using bio-plastics instead of petroleum-filled plastic —plant-based polymers— which need little power and fuel to manufacture when compared with conventional plastics. There is also a hurdle to maintain these computers of bio-plastic with less heat so that they do not get damaged by melting. As for landfills, operators should monitor them by optimally using the equipment by toning-up and mending in a timely manner to make such a process prompt and economical.

6. Limitations of Green Computing Procedure

The author perceived some limitations in coping up with virtualization and earning revenues from virtualization. It is possible that companies will have to depend on one or two such sellers who might charge exorbitant amount for virtualization and also create monopoly.

Moreover, virtualized desktop creates dependence on concentrated servers, which could render the end clients helpless against servers.

7. Future Scope

It is expected that various clients could slice at an individual workstation by necessarily adjoining multiple screens up to ten screens, keyboards, mice. The next scope is to develop an innumerable data to be assembled together or stored either physically or virtually, for the administration, stockpiling, and segregation of data. Data can be sorted out across a particular blend of training or relating to a specific business. **[10]**

8. Conclusion

Until now, consumers are more concerned about the cost and speed of computers while buying them and less on their ecological impact. However, according to Moore's law, in the future, consumers will become aware of *green computing* and be more

inclined to buying *green computers* preferring devices which have maximum productivity with the least power consumption. As widely recognized, the computing industry is still the most advanced and ever-changing industry. Therefore, it is hopeful that only within a few years ahead, most computers should become *green computers* with minimal waste as possible.

9. The Author

Gaurav Sengupta is a lecturer in the Department of Aviation Maintenance, Siam Technology College, Bangkok, Thailand. His areas of interest include Green Computing and its applications covering concerns with efficiency in usage of energy and reduction of e-waste.

10. References

Bhide, A.D. (1994). Methane emission from landfills. *Journal IAEM, 21*, 1-7.

Binder, W & Suri, N. (2009). *Theory and Practice of Computer Science*. SOFSEM, pp. 117-128.

BIOPLASTICS Facts & Figures, European Bioplastics. Accessed in June 2019. Retrieved from https://docs.european-bioplastics.org/publications/EUBP_Facts_and_figures.pdf.

Dhir, R. (2012). Green Computing--The New Era of Energy Efficient Computing, *International Journal of Computers & Technology*, *3*(1), 173-175, August, 2012. Council for Innovative Research, www.ijctonline.com ISSN: 2277-3061.

Gary, B. S. (2002). The Components of a Computer. *Discovering Computers: Concepts for a Digital World.* First edition, pp.1-5. ISBN-13 978-0789565129.

Kimbahune, V, Deshpande, A and Mahalle, P. (2015). Green Engineering: Future Internet Perspective. *CSI Communications*, *39*(5), 10-11 (August 2015).

Liu, Z., Ma, R., Zhou, F., Yang, Y., Qi, Z. & Haibing Guan, H. (2010). Power-aware I/O Intensive and CPU-Intensive Applications Hybrid Deployment within Virtualization Environments. A paper presented at International Conference on Progress in Informatics and Computing, Shanghai, China-Publishing IEEE.

Malviya, P. & Singh S. (2013). A Study about Green Computing. *International Journal of Advanced Research in Computer Science and Software Engineering*, *3*(6), 790-794, June 2013, ISSN: 2277 128X.

Murugesan, S. (2008). Harnessing green IT: Principles and practices. *IT professional 10.1*, pp. 24-33.

Puckett, J., Byster, L., & Westervelt, S. (2002). *Exporting Harm. The High-Tech Trashing of Asia.* Pennsylvania: Diane Publishing Company.

Rohini, V. & Sundarkumar, R. (2014). Green Computing: A Methodology of Saving Energy by Resource Virtualization. *International Journal of Computer Engineering in Research Trends (IJCERT), 1*(1), 8-14 (July 2014).

Roy, S. & Bag, M. (2013). Green Computing--New Horizon of Energy Efficiency and E-Waste Minimization – World Perspective vis-à-vis Indian Scenario. *Computer Society of India (CSI), 1*(1), 64-69.

Sinha-Khetriwal, D. (2002). *The Management of Electronic Waste: A Comparative Study on India and Switzerland*. St. A Master Degree Thesis (M.S.), University of St. Gallen, Switzerland.

Sivaharan, T., Blair, G. & Coulson, G. (2005).*GREEN: A Configurable and Re-configurable Publish-Subscribe Middleware for Pervasive Computing.* Lecture Notes in Computer Science. New York: Springer Publishing, pp. 732-749.

Srivastava, M. (2005). Concept of Green Computing. *Chemistry for Green Environment*, p. 108. ISBN 9780128092705.