Green Computing: As an Emerging Trend

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Abstract-- Green computing, also called green technology, is the environmentally responsible use of computers and related resources. 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).Green computing has different technologies which includes Carbon-free computing, Lead-Free and RoHS computing, Solar Computing,Energy-efficient computing. Green computing also has some advantages and some disadvantages.

Keywords--green computing, technologies, advantages, disadvantages

I. INTRODUCTION

Green computing, also called green technology, is the environmentally responsible use of computers and related resources. 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).[1] It also refers as refers to environmentally sustainable computing. It is study of subsystems—such as monitors, printers, storage devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment.[2] Green computing includes:Using resources in such a way that reduces the usage of hazardous materials, Designing objects and services that comply with the environment, Recycling e-waste with no or little impact on the environment and the discovery and development of new products that reduces or eliminates the use or generation of hazardous substances in manufacturing.[12]

II. HISTORY OF GREEN COMPUTING

The term Green computing came into existence with thelaunch of Energy Star program in 1992 by U.S environmentalprotection agency. Energy Star is a kind of label awarded tocomputers and other electronics products. Energy Starprogram minimizing the use of energy while maximizingefficiency. One of the first approaches towards greencomputing was sleep mode function in computers. Sleep Modefunction which places a computer on standby mode to a presetperiod of time.According to Wikipedia “The Swedish organization TCOdevelopment launch the TCO certification program to promotea low magnetic and electrical emission from Cathode RayTube (CRT) based computer display; this program was laterexpanded to include criteria on energy consumption,ergonomics and the use of hazardous material inconstruction”.[11]

III. TECHNOLOGIES GREEN COMPUTING

1. **Carbon-free computing:**
   VIA is a Taiwanese chipmaker that makes very power-efficient processors for computers and mobile devices. VIA has started a program called "carbon-free computing", where they offset the carbon that will be produced by the manufacturing and lifetime energy use of their CPU's. They do these offsets by building renewable power generation in developing countries, restoring forest and wetlands, and doing energy conservation.[3] According to the company, VIA works with environmental experts to calculate the electricity used by an average Carbon Free Computing product over its lifetime, assumed to be 3 years. Then from the amount of electricity used, VIA calculates how much carbon dioxide emissions will be released into the environment mainly as a result of fossil fuel burning power plants, and then works with regional offset organizations to "offset" that amount of carbon dioxide through projects such as reforestation, investments in alternative energy, and Energy conservation.[4]
2. **Lead-Free and RoHS computing**
   In February 2003, the European Union adopted the Restriction of Hazardous Substances Directive (RoHS). The legislation restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. The directive is closely linked with the Waste Electrical and Electronic Equipment Directive (WEEE), which sets collection, recycling, and recovery targets for electrical goods and is part of a legislative initiative that aims to reduce the huge amounts of toxic e-waste. [5]
   RoHS is often referred to (inaccurately) as the 'lead-free directive', but it restricts the use of the following six substances:
   Lead (Pb)
   Mercury (Hg)
   Cadmium (Cd)
   Hexavalent chromium (Cr6+)
   Polybrominated biphenyls (PBB)
   Polybrominateddiphenyl ether (PBDE) [6]
   RoHS and other efforts to reduce hazardous materials in electronics are motivated in part to address the global

issue of consumer electronics waste. As newer technology arrives at an ever increasing rate, consumers are discarding their obsolete products sooner than ever. This waste ends up in landfills and in countries like China to be "recycled."[7]

3. **Solar Computing**
Solar power is the use of the sun's energy either directly as thermal energy (heat) or through the use of photovoltaic cells in solar panels and transparent photovoltaic glass to generate electricity.[8] 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.Solar cells 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-1‖ initiative, the company established the first-ever solar-powered cyber community center in the South Pacific, powered entirely by solar technology.[9]

- Energy saving Environmentally Friend
- Save more money per year
- Green computing techniques will actually translate into a much lower carbon dioxide emission
- Reduced energy usage from green computing techniques translates into lower carbon dioxide emissions, stemming from a reduction in the fossil fuel used in power plants and transportation.

4. **Energy-efficient computing**
Energy efficiency is *the* key design challenge for future computing systems, ranging from wireless embedded client devices to high performance computing centers. The Energy Efficient Computing Systems (EECS) research initiative was established in 2012 to respond to the challenges met in the current socio-economic context. [10]

I. Disadvantages of Green Computing

- High startup cost
- Still in experimental stages
- Some computers that are green may be considerably underpowered.
- Rapid technology change [13]
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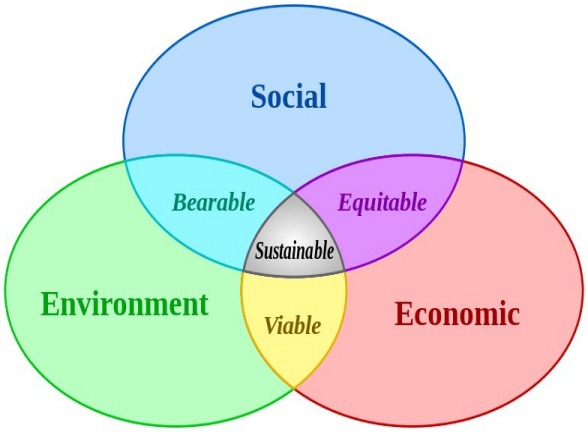
II. Benefits of Green Computing

1. Environmental Sustainability – Green IT ensures the diversity and productiveness of the biological systems since it reduces negative impact of the processes through green use, design, disposal and green manufacturing.

IV. ADVANTAGES OF GREEN COMPUTING

- Conserving resources means less energy is required to produce, use, and dispose of products.
- Saving energy and resources saves money.
- Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses.
- Reduce the risk existing in the laptops such as chemical known to cause cancer, nerve damage and immune reactions in humans. [13]



Environmental Sustainability
It not only ensures the environmental and social sustainability but also economic sustainability which is necessary for the survival of human beings.

2. Better Resource Utilization – Green computing is a powerful approach to utilize resources such as office space, data centers, computers, heat, light, electrical power etc. in an environmental friendly way.

3. Cost Saving – Since you're utilizing resources efficiently through green computing, there is a significant saving in the total operational costs.

4. Improved Corporate and Social Image – Green computing is a big hand for the businesses to improve their corporate image by meeting compliance and regulatory requirements. It also a good way to meet sustainability demands of the customers and employees.[14]

V. SUMMERY

It can be observed that green computing is the need of thehour to protect the environment. As more and more time passesthe need of computers as a dependable machine increases and so
does its use. So computer penetration is increasing globally at anamazing rate. This makes it all the more necessary to maintaingreen computing procedures throughout the life cycle of acomputer from manufacturing through day-to-day operation tillthe end of its operating stage.

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