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Power Saving Strategies-Green Computing

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***Abstract*—** Green computing is one of the important aspects in which manufacturing, clearing and recycling of electronic devices are taken into account. The ultimate aim of green computing is to produce possibly less harm to the environment and to promote optimal usage of power in an eco-friendly manner. Equipping electronic devices in a large scale all over the globe leads to the environmental degradation because numerous tons of carbon-di-oxide is produced indirectly due to computation. A unique team is working in testing and applying eco-friendly materials in computation. The main idea is to reduce the environmental impact of industrial process along with innovative technological growth. In this paper we discuss about the average power wastage due to computing and also the ways of green computing effectively with power saving ideologies including natural resources and sensors.

***Keywords*—** Green computing, electronic devices, eco-friendly, power, sensors.

I. INTRODUCTION

During recent years, the main focus of 'green computing' has been moved to power saving techniques for domestic as well as industrial purpose. The term 'green computing' refers to the usage of computers and its related devices in an effective manner so that it has negligible or no effects on the environment. Initially, computing in IT sectors leads to production of carbon-di-oxide and other emissions which causes global warming and environmental degradation. This is because of the increasing energy requirements in IT industries. Also disposal of e-waste and recycling of those materials inherits critical situation.

As electricity is indispensable for computing, it is used in large scale in all industries. We are also aware that the cost of energy per unit and the requirements of energy is increasing on daily basis. So in this situation 'green computing' can only extend its hands to help industries to reduce wastage of energy in large scale and can conserve it for future. On the other hand, a study conducted by 'The Climate Group' predicts that green-house gas emissions that are carbon-di-oxide emissions will increase to 1.3 Giga-tons (approximately). So to reduce the carbon-footprints and Energy consumptions new power saving strategies are very essential.

In this paper we have firstly discussed about the power consumption by a basic computer and its consequences. In the next section we have presented a few computing technologies that are used by industries. Then, we have listed few points on why one should follow green computing technology both in industries and households. Then, we have given few ideologies that can be applied in industries so that power wastage is considerably minimum. Preceding that, we have discussed about few hazardous chemicals that should be handled with care during recycling and disposing. Then, we have given some suggestions regarding usage of renewable resources in computing for minimizing power wastage. Following this we have also mentioned some current Green IT trends. Finally, we have discussed about the implementation of sensors in computing to reduce power wastage when a computer is in ideal. We have concluded the paper with future directions of green computing.

II. POWER CONSUMPTION

A complete desktop uses an average power of 200 watts per hour [including power consumed by desktop itself, internet, printer, headphones]. Let a system of this setup runs 8 hours per day, then the average power consumption per year will be around 600 kilo watt hour. This in turn produces 175 tons of carbon-di-oxide emission. Hence, to be eco-friendly, industries are pushed towards harnessing power from renewable recourses and to consider the usage of power in an effective way.

III. POWER CONSUMED IN INDUSTRIES DUE TO COMPUTATION

- In industries, due to recent modern technical developments, many works are preferred computerized rather than performing manually. Due to the

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developments, many machines have been operated using computers, also in many sectors most of the operations depends on computing or computing devices. Also nowadays, usage of man power is less as automation plays a vital role everywhere in every field by means of computing.

- In industries man power is replaced by automated machines with the help of computers which leads to power wastage. As a computing devices are aligned to only to do a particular work that occupies less memory, whereas the power input and cooling system is provided for whole computer's memory.

- Due to rapid modern development of Multi-National Companies all over the world especially in developing countries, much technological equipment has been industrialized. Because of these developments, there is a need of using computers widely in every field. Hence, these wide usages of computing devises consume more amount of power than expected.

- During the computer operation in weekends where fewer amounts of labors has been employed, the same energy has been consumed.

- Despite, being modernized there are still many ways to minimizing power consumption to operate computers in industries.

- The man power is being replaced by computers in industries in the name of automation majorly aiming for profit and ignoring the environmental degradation factors due to computing in a large.

- Though power is wasted by workers due to improper visualization of computers properly after the completion of their job and at the time of leaving, the power wastage is more than the average power wastage due to workers.

Figure 1. This image illustrates the concept of green computing clearly without language.

IV. WHY GO GREEN?

- We are aware that computers, laptops, servers etc., and other physical components of a network requires a lot of electrical energy for computing. As a result, tons of carbon-di-oxide is produced which leads to global degradation.

- Also due to computing, a large amount of heat is produced; if the system is not provided with proper cooling system it may cause damage. So, for maintaining an optimal temperature, one should depend on electrical energy.

- When some parts of the system or the system itself becomes waste, it should be disposed or recycled eco-friendly as it may contain hazardous chemicals such as mercury, sulphur, lead, beryllium oxide etc.

- Once a system is disposed it should be replaced by newer ones. So, we should depend on manufacturers. At the time of manufacturing several hazardous chemicals are used.

Hence, to save our fragile planet from exploitation and to overcome the above difficulties, we need to research and employ green computing techniques.

V. MANAGING POWER USAGE TECHMICALLY

- Normally, only 10-15% of the server's processing capacity is used. At the same time, only up to 50% of the total memory space is consumed during the run time. Industries pay even for the remaining percentage of memory of the server. Also cooling is also provided for the remaining unused percentage of the server. If that is the case usage of the systems can be made highly efficient by employing **virtualization** technique. As it allows us to integrate two or more loads to a single host cooling cost and energy consumption will be reduced making the whole system work effectively.

- When energy consumption is less it reduces the production of emission of greenhouse gases. This in turn reduces the cost of computing in the IT sectors. According to a survey by Environmental Protection Agency based on **e-waste**, around 133,000 personal computers discarded by the United States homes and business organizations every day and only less than 10% of these are recycled. So, recycling these e-waste materials [including mercury, lead etc.] can reduce the cost of production and produces no harm to the environment otherwise these will produce landfills affecting both land and underground water table.

- Usage of eco-labelled appliances is advisable as it indicates if the appliances are power efficient or not on comparison with products alike. There are also other equivalent labels like European Union Energy label,

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yellow Energy Guide tags etc. Carbon Emission labels are an alternative certified labels that reduces the impact of carbon-di-oxide production.

- **Data compression** along with **cloud computing** is an effective way used in IT sectors recently. The compression technique can be used to compress the data and remove any unwanted or copy data. This reduces the storage space and promotes effective computing. When these compressed data are stored in clouds the process of retrieving and maintaining the servers becomes easy and effective providing comparatively less cooling power supply to that of the maintenance of uncompressed data.
- Since **Liquid Crystal Display (LCD)** monitors can provide with high resolution than **Cathode Ray Tube (CRT)**, replace display withmonitors. As CRTs are bulky it is difficult to cool it easily whereas LCD screens are slim and hence with minimum energy we could maintain an optimum temperature. Also the most important aspect in LCD is that it can be recycled with ease when compared to CRT making computing turn green.

VI. CHEMICALS TO BE DISPOSED WITH CARE

A. Berylliyum

Beryllium is usually used to make an alloy which is more efficient than normal copper wires**.** Exposure to beryllium even at very low levels could cause beryllium sensation. Some people can even get Chronic Beryllium Disease (CBD). In many cases, it has been misdiagnosed or undiagnosed disease causing berylliolisis. Before it was not considered to be too significant, but nowadays research reveals that it can cause genetic disorders.

B. Cadmium

Few models of laptops have Ni-Cd [nickel-cadmium] rechargeable batteries. Old CRT has cadmium compounds in it. Recycling of these cadmium compounds is a tedious process. It is toxic to plants, animals, humans and having no positive biochemical significance. It is so dangerous as its inhalation can even causes lung cancer. Also it has been banned in most of the European Union countries.

C. Lead

Lead that is used in CRTs and soldered circuits can diffuse from the e-waste dumped as land-fills which under particular conditions makes the air rich in lead. In humans any form of lead (that is either by inhalation or by ingestion) can cause damage to circulatory system, nervous system, urinary system and reproductive system.

D. Mercury

Mercury is used in lights that are used for illumination of display screens. Mercury is released during the process of dismantling of computers. This when passes inside the body can affect the Central Nervous System of the human body. It also causes great damage to nephrons of kidneys and affects the reproductive system.

Though there are many other toxic chemicals such as bromine, poly vinyl chloride, phthalates, organotin, chromium hexavalent etc.; the chemicals such as mercury, lead, cadmium, beryllium causes comparatively more significant damage to both environment and living community.

VII. USING RENEWABLE RESOURCES:

Now-a-days, the energy requirements are increasing day by day along with the need of harnessing energy from renewable resources among industries. Also, IT sectors are preferable in energy as they know the significance of conserving energy and reducing wastage of energy in order to reduce the cost of computing. The data servers of Google, yahoo, Microsoft uses renewable energy and stands as a good example for ‘green computing’.

Though we cannot make the whole industry go green, we can at least make few parts of the industrial network work with renewable energy. This can also contribute in reducing carbon footprint percentage produced annually by a sector.

Figure 2. Illustration of significance of harnessing renewable resources for computation.

The ways of harnessing renewable energy are as follows:

A. Solar energy

This is one of the effective ways of harnessing renewable energy from every part of the world. Though the initial setup cost is high when compared to the cost of computing with electricity is much lesser than the setup of harnessing solar energy. Once if it is equipped, it will long for several decades under controlled conditions. Though one cannot make the whole industry go green with solar energy, it will be helpful to some extend reducing cost of computing thereby reducing the emission of greenhouse gases. If an industry could produce 50 Mega Watt per year, it can reduce up to 127 Mega tons of CO2 emission per year. So this saves a considerable amount of energy.

B. Geo-thermal energy

A good Geo-thermal heat pump uses ambient Earth to improve cooling. A deep well circulating water to extract

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temperature (roughly 2 gallons per minute); this is an effective way which can be setup everywhere. It is very comfortable in extracting heat from the earth underneath as it provides quenching of heat in summers and warming of places under freezing conditions in winter. Though this seems to be very comfortable the quality of water matters as it may damage the coil of cooling machines.

VIII. SENSORS

A study conducted by the California Plug Load Research Centre, shows that out of 125 office computers 61 percentage of their time is left ON with in active user, last year in U.S.A. So this leads to environmental degradation without any profit to the people who are responsible for this. We are already in a situation to use renewable energy to go green; in addition to this we must also bear the loss produced due to the inactive user. Hence to overcome these difficulties we can employ suitable sensors such that the power is switched-off when user is not present.

Another survey held by Environmental Protection Agency says that 30 to 40 percentages of personal computers are kept ON after office hours and around 90 percentage of the personal computer are left ON in weekends. So in order to overcome this, every monitor/CPU/server should be manufactured with a thermal sensor such as OMRON-D6T. These sensors possess the capability of sensing the human activities. So it must be designed in such a way that it should turn on sleep mode automatically when the user is inactive.

As we all know that PCs in sleep mode will use only one-third of total current. Also we should design it in such a way that it gets switched off automatically after a particular time when not in use based on the requirements. Meanwhile it should also save the work that user was performing before he/she left the PC ideal. Because of this, we will be able to save a considerable amount of energy that is wasted in non-working hours.

Also when PCs are no more in use the cooling system of the industry will be working round the clock wasting energy in cooling the unused PCs. So such sensor can also be implemented in monitoring cooling systems thereby saving that energy too.

ALGORITHM**:**

PROBLEM**:**

To reduce the power waste due to the computing using sensors in industries.

INPUT**:**

Required sensors.

OUTPUT**:**

Reduced power wastage

STEPS:

i. Manufacture the device along with a thermal sensor to know about the human activity.
ii. Program it in such a way that when the user detection fails, it should activate sleep mode starting a timer.
iii. When the default time is reached turn off the device.
iv. Save the file/program/anything that user was doing before he/she leaves.
v. Make a note the saved files and its default locations and save it in desktop itself. {So that user knows where the last worked file was saved by the computer.

IX. COMPARISON WITH CURRENT TRENDS

In industries there are several technologies used currently to maintain and reduce the power usage and prevent it from being wasted. These technologies include build in and purchasable applications that can run in our computer to monitor the power wastage and to use it efficiently. Nowadays software like INTEL POWER MANAGER, GRANOLA are used in computer networks to save the power that could be wasted. Also for computers using browsing as their main area are using BLACKLE which is product of Google to do their work since, browsing in BLACKLE can save up to 75 percentage of display power. Also using the concept of green architecture todays OS are by default manufactured with POWER PLANs which enables the user to use various techniques such as “shut down every night automatically at specified time” so that even if the computer is left ideal the power will be saved. But, the above discussed idea of using sensors in the field of computing could reduce the power wastage when the computer is left ideal. By using the ideas discussed above one can reduce even small quantities of power that could be wasted which when integrated becomes a significant quantity.

Though we cannot reduce the greenhouse gas production as a whole by implementing the above ideas we will be able to save our Earth from being degraded. Hence, if the above mentioned proposals are taken up to practice in industries they will be able to lower the power that is wasted in industries thereby reducing the cost of computing which paves way for less production of greenhouse gases.

X. CONCLUSION

Green computing presents a responsible way to address the so called issue Global Warming. The field of green technology encompasses a broad range of subjects from new energy harnessing techniques to prevent the loss of energy due to computing. It has taken upon itself the aim to provide society’s needs in such a way that it does not damage natural environment. Mainly this means creating full recyclable products, reducing pollution, proposing alternative technologies in various fields and creating a center of economic activity around technologies that benefit the environment.

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A huge amount of computing manufactured in the world has both direct impacts such as landfills, water spills, water table contamination etc., due to e-waste and indirect impact such as production of greenhouse gases which causes global warming thereby causing climatic changes all over the world.

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