

Green Computing: Issues on the Monitor of Personal Computers

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Abstract: Green computing is now a days becoming a research problem and many scientists are focusing their attention to do research on various issues related to this discipline. The topic addresses issues such as , effective power utilization, maximizing efficiency, maximizing efficiency of utilization, correct disposal of electronic gadgets, reliable and cost effectiveness etc. One of the most used components by ICT group are personal computers and hence considered for our analysis under green computing. Any personal computer has major functional components such as CPU, memory , monitors and peripheral devices etc. Each components have certain contribution towards green computing. The main focus of attention of this paper is to study how the power consumed by each functional units are effectively minimized so as to perform the job without any deviation while using the personal computer. Power thus saving is equivalent to power generation or optimal usage. Since there are many functional units present in a personal computer, in this paper, we discuss how monitor is contributing to the green computing by conducting various studies on different types of monitors. Results and discussions are presented. The work related to the memory and the processors are in progress.

Keywords: Green computing – Personal computers – Effective Power utilization – Contribution from Monitors

I. INTRODUCTION

Green computing is a new technology that is now under attention of business, industries for the energy efficiency and to dispose E-waste in an effective and harmless way. They now come to realize that going green is in best interest, both in terms of public relations and reduced costs. Thrust of computing was initially on faster analysis and speedier calculation and solving of more complex problems. But in the recent past Green computing has got immense importance and that is achievement of energy efficiency, minimization of power consumption of e-equipment. It has also given utmost attention to minimization of e-waste and use of non-toxic materials in preparation of efficient computers and E-electronics. The main objective of this technology is to study and practice computing resources efficient and eco-friendly. Maximizing the energy efficiency and to promote biodegradability are the primary focus of this technology. Due to pollutants generated by it and the steady increase in rates, energy consumption is causing a serious environmental and economic problems. Regarding energy efficiency, a branch of Green IT named energy-aware computing has evolved[1]. Green computing is very much essential for the future world. It is required to make our self and our environment healthy. It can be defined as responsibly utilizing the resources available. Many computers are produced from many hazardous materials like cadmium, mercury and other toxic substances. While disposing the computers, it will lead to pollution and affect the environment to a great extent. This field encompasses a broad range from new generation techniques to the study of advanced materials to be used in daily life. Bringing it to practice will address many problems that are being a threat to human life and our environment.

The impact of the toxic wastes that are produced by us through throwing our old computers and peripherals lead to land pollution. The computers have the power hogs that generate pollution by the energy they consume for their processes.

Green computing addresses many problems. To be in precise, the goals are (which are collected from various literatures as mentioned in reference)

- To reduce the power consumption of the products
- To reduce the harmful effects to the environments through the use of hazardous materials
- To increase the life time of the product
- To maximize energy efficiency during the product's lifetime
- To promote recyclability of defunct products and factory waste

Power dissipation is also a major concern in portable, battery-operated devices that have proliferated rapidly in recent years. Each of us has experienced the event that the battery of our laptop or mobile phone is depleted. The issue is even more serious in autonomous, distributed devices such as sensor networks where the charging of batteries is difficult or impossible. Finally, energy dissipation causes thermal problems. Most of the energy consumed by a system is converted into heat, resulting in wear and reduced reliability of hardware components[2-5].

In this study, our main focus is on the effective utilization power for monitors which is attached with a personal computer system for display of outputs. For every completed work or the partially completed work, the results are to be displayed on the monitor for providing the result and feedback. Typically if we look at the power handled by a system, it is the total power consumed by the sum of power handled by each functional components such as Processor, monitor, hard disk, DVD, VGA, PCI, motherboard, RAM and peripherals. Among these eight parameters, we have considered only three major components, namely, monitor, memory and processor for various cases of instances. For a Celeron and P-IV processor, the power consumed by various components are illustrated in the following Pie chart[7].

The pie charts are drawn using the details of the processors collected from the literature [7].

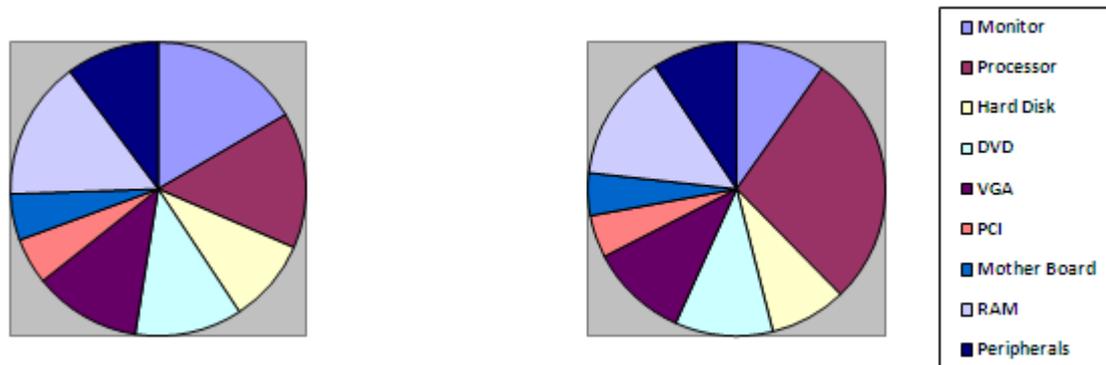


Figure 1. Pie Charts for the Power consumption in Celeron and P-IV based systems

The above figure is drawn for the Celeron and the Intel P-IV processors whose details are given[7]. Our idea is to present various implications of monitors in a personal computer in Green computing perspective. The organization of the paper is as follows. Second section of this paper discusses about the proposal of the work and third section presents the methodology and the calculations. Fourth section presents the results and discussion. Finally fifth section illustrates the conclusion and further scope for the present work.

II. PROPOSAL

Saving power is the main objective of Green Computing and that is also with minimum impact to the environment. It is about how to reduce the power consumption of the monitors to save energy, increase the life time of the product and also to make it efficient. "Faster processors use more power, because they use too much power and their waste heat increases temperature for which air conditioning necessary, especially in server farms--between the computers and the HVAC. The waste heat also causes reliability problems, as CPU's crash much more often at higher temperatures"[5,6]. A bus is simply a circuit that connects one part of the motherboard to another. The more data a bus can handle at one time, the faster it allows information to travel. The speed of the bus, measured in megahertz (MHz), refers to how much data can move across the bus simultaneously. Bus speed usually refers to the speed of the front side bus (FSB), which connects the CPU to the north bridge. Since the CPU reaches the memory controller through the north bridge, FSB speed can dramatically affect the performance of the computer. From the motherboard, the data to be displayed will be sent to the monitor through the bus.

III. Methodologies

Monitors are the primary output device in a system. It is the one produces visuals for human being to perceive. They consist of a display and an enclosure. They are mainly of three types, namely,

- ✓ Cathode Ray Tube (CRT)
- ✓ Liquid Crystal Display (LCD)
- ✓ Light Emitting Diode (LED)

3.1 Cathode Ray Tube

These are the oldest type of monitors that were used in the past. They have better viewing angles. But it is a power hog which consumes very much power in comparison with the other types. The cathode ray tube

(CRT) is a vacuum tube containing an electron gun (a source of electrons or electron emitter) and a fluorescent screen used to view images. It has a means to accelerate and deflect the electron beam(s) onto the fluorescent screen to create the images. The image may represent electrical waveforms (oscilloscope). CRTs can emit a small amount of X-ray radiation as a result of the electron beam's bombardment of the shadow mask/aperture grille and phosphors. The amount of radiation escaping the front of the monitor is widely considered harmless. The CRT monitors in our work is SAMSUNG. CRT monitors typically consume 150 W of power.

3.2 Liquid Crystal Display

LCD monitors got fame for their flat panels, low power consumption and less space. It uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in most applications. The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. Depending on the set display brightness and content being displayed, the older CCFT backlit models typically use 30–50% of the power a CRT monitor of the same size viewing area would use. Many LCD monitors are powered by an external 12v power supply, which means that (with a proper cable) they can also be run directly on one of the computer's 12v power supply outputs, removing the overhead and quiescent power consumption of the monitor's own power supply. This can increase the power efficiency, especially if the computer has a high-efficiency PFC power supply. This is also convenient because the monitor will power on when you turn on the computer, and will power off when the computer sleeps or is shutdown. The LCD monitors used is ACER 16" LCD Monitor which consumes around 30W.

3.3 Light Emitting Diode Display

An LED display is a flat panel display, which uses light-emitting diodes as a video display. An LED panel is a small display, or a component of a larger display. It is mainly used to backlit the LCD display which don't have ability to display true black colors. There are two types of LED backlighting techniques used. One is RGB dynamic LED and the other one is edge LED. The former type of backlighting uses LEDs placed behind the LCD TV or monitor screens, while the latter uses LEDs placed around the monitor rim, from where light is made to diffuse behind the screen. Since LEDs are placed around the rim on edge LED monitors, they can be a lot slimmer than conventional LCDs.

IV. RESULTS & DISCUSSION

Here We discussed the cases by changing the type of monitor we are using. We considered a CRT monitor of 16 inches, LCD and LED monitor of the same size.

Table1. System with different functional units and the power utilized.

Sl no	Functional units	CRT (in %)	LCD (in %)	LED (in %)
1	Monitor	35.71	10	6.9
2	Peripherals	4.76	6.67	6.9
3	VGA	9.52	13.33	13.79
4	MB	2.38	3.33	3.45
5	HD	4.76	6.67	6.88
6	DVD	5.95	8.33	8.62
7	RAM	7.14	10	10.34
8	Processor	29.78	40	41.38
9	CPU	59.52	83.33	86.2
10	Total Power (Monitors + CPU + Peripherals)	150 + 250 + 20 420 W	30 + 250 + 20 300 W	20 + 250 + 20 290 W

Power handled by the functional units are as above. The last row infers that if the CRT power is 100%, then the power handled by the LCD is of 71.4 % and that of LED type monitor is 69 % when compared to the CRT monitor. The power saving between LCD and LED type monitors are not appreciable whereas to that of CRT type monitor, the saving is enormous. If the power saving is 40 W for example, then for 100 such type of monitors, will save 4KW and so on. By changing the brightness of the LCD monitor, the power consumed by

the monitor can be adjusted and still can be reduced as follows and shown in Table 2. Table 3 gives the comparative requirement of power by LCD and LED type monitors when compared to CRT type monitors.

Table 2. COMPARISON OF LCD AT DIFFERENT BRIGHTNESS

Brightness	70%	20%
Contribution to computer's power	98% of normal	95% of normal

Table 3. LED MONITOR COMPARISON BETWEEN MONITORS POWER

	CRT	LED	LCD
Comparison of computer's	100 %	71.4% OF CRT	69% OF CRT

From the table1, it is observed that the total power requirement when we use CRT monitor, is higher as good as 420W when compared to 300 W for LCD type monitors and 290 W for the LED type monitors. The same information are illustrated in the form of a graph as shown in Fig.2a below. Figure 2b infers that the percentage of power requirement by the CRT , LED and LCD type monitor in a personal computer. The figures in 2, implies that the power requirement in CRT type monitors are much higher than those of LCD and LED type monitors. The power requirement in the LCD and LED type monitors are further negotiated by the recommendations of the present survey, power saving is assured which is a component in green computing.

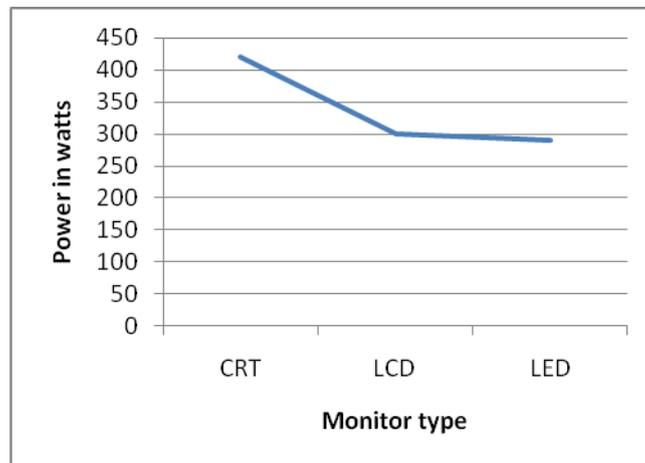


Figure 2(a)

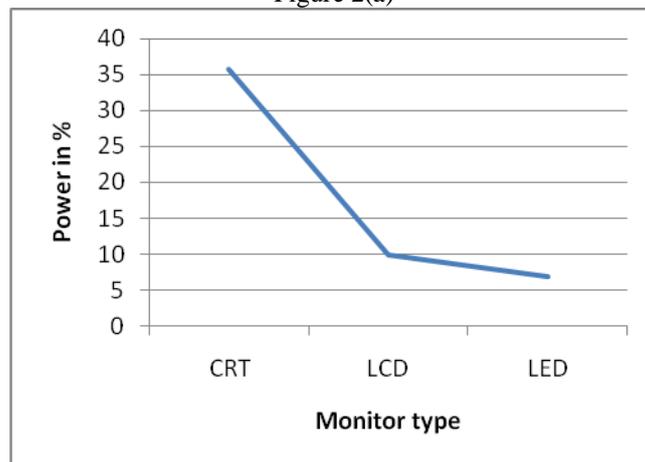


Figure 2(b)

Figure 2 a. Power requirement for Personal computer with three types of monitors
Figure 2 b. Power in % requirement for three types of monitors

When there is no need for the monitor for the time being, then the monitor can be switched to either off state or the sleep state or low power states. The mode to which the monitor is switched any one of these states is decided case by case by the user. Suppose if the monitor is switched to low power or sleep state, then the activation requires more energy than the saving of power due to keeping the low power or sleep state. This problem could be solved by leaving the responsibility to the program itself. i.e. when the computer is involved with large computation, say, at least one hour, then the operating system can make the monitor switched off automatically. When the computation is about to be completed the monitor may be switched on. This is totally relieving the intervention of human beings in between the process. Quite often if the monitors are flipped between these states, they may require more power than that of saving. The consequences are illustrated as follows.

4.1 Sleep State Mechanism

When the computer is idle, the power can be saved by turning off the monitor. But it is never known whether the user is watching the screen or went away. So it is safer to gradually lower the brightness of the system which will save power. Many considerations have to be made before doing anything. Consider the computer at active state that is the full power state. When it remains idle, it will be pushed to a lower power state. i.e., the sleep state. The power required to wake it up from lower state to higher power state is also more. So when the power range between the lower state and higher state are larger, the igniting energy required to make transition is also higher. So in case of frequent recalling to the idle state, the igniting energy will overtake the saved energy and will result in energy loss. When the number of intermediate states are increased, we can think about saving power in these states.

4.2 Transition states

If there are many lower level states S_1 , to S_n , the sleep state, when the monitor is switched off. S is considered as the active state. The power saving through monitors by reducing the igniting power. The igniting energy required depends on the extend in which the monitor was in sleep state. Then it will cause loss of energy. So when a user wakes up a state from the lower power state to higher power state before a certain time interval, then it should be made to remain in that state for the remaining time to make it for the loss. The above said statement is not possible in all the situations. When the user is in a urgent job to complete, we cannot make him to wait till the time interval is over. So for that we need to find an alternative. Instead of waking it to the active state S , we can make the state to transmit from lower power state to the next higher power state. That is from S_i to S_{i-1} , which will have lower ignition power than the active state comparatively. If we keep that state for a few more time, we can make up for the energy required to ignite. Then we will make progress to the next higher power state and so on till the active state. This kind of transition between the states will save considerable amount of energy when the system remains idle for some time.

For a given specification, experimentations have been performed for exhibiting the usage of various types of monitors such as CRT, LCD and LED display devices. For ease of comparison, 16" dimension for different type of monitors are considered. The variations of power handled by different computers and the power handled by the three types of monitors and are shown below.

V. CONCLUSIONS

The power consumption of the three different types of monitor and their impact to the power consumption of the system is analyzed successfully and the comparison is provided. The importance of using flat panels is explained. The encroachment of brightness of the screen with the power consumption of the monitor is also analyzed and explained above. The criticality of bringing many lower power states in between the sleep and active states is also discussed with the consideration of the ignition power. This research survey exhibits on effective utilization of various types of monitors on the normal usage of personal computers.

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