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How to Have Your Monitors Consume Less Power

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Abstract— This Technical paper is a minute yet effective attempt to prove that how a large amount of energy can be saved by just being aware of the current computer technologies. We have suggested methods which if followed can save a lot of our energy. At present this saving may appear negligible but if implemented on the national level, we are sure that these methods can bring about significant changes. We have discussed and statically shown how much power consumed by various type of display devices used with computers depends upon what they are displaying. Thus not only the type of display device but what is being displayed decides as to how much power will be consumed. So even without changing the display device we can decrease the power consumption by following some very simple steps. We have used the test case of a college to show how these small can produce some significant effects.

Index Terms— Black Background, Cathode Ray Tube Monitor, Electron, Energy, Pixel, Power Wastage, Liquid Crystal Displays

1. Introduction

Today is the time when the whole world is experiencing ing energy crisis and the situation is going to be worse in worse in the near future. This can be speculated by observing that today, not only the country's economic policies but even its foreign policies have become power driven. The problem is intense and requires us to utilize every bit of energy as efficiently as possible. Government is taking initiatives to preserve environment and energy, but no plans can succeed unless every individual is aware of the problem and understand that any effort made at individual level to conserve environment makes the difference.

The rest of the paper discusses related work in section 2, and then describe our proposal in section 3. Section 4 and 5 describes the changes we can make while section 6 describes how we evaluated our system and presents the results. In the end we present our conclusions and describe future work.

2. Related Work

Earlier attempts have been made for saving the energy wasted by display devices used by the computers. Until few years back CRT (Cathode Ray Tube) was the major technology used in display devices. Due to large amount of power consumption by the CRT monitors and their size, trend is now shifting towards LCDs (Liquid Crystal Displays) monitors. The technology used in LCDs makes them power efficient. Shifting to LCDs does save energy, but following factors give ordeals to the goal of saving energy –

i) The cost difference between the LCDs and CRTs is significant, making it inapproachable for considerable number of people due to economic constraints.

ii) LCD is relatively new technology for the developing countries like India, China, Pakistan, Brazil etc. where a bulk of population still use CRT.

3. Our Prosposal

We suggest a solution, backed by statistical data, to the problem. Our solution is general in nature as it is applicable from the old technologies like CRT to the latest one like PDP. The solution is based on technology used in various types of display devices to generate different colors. Consider the case of CRTs. A CRT monitor uses a cathode ray tube to display images. The back of the tube has a negatively charged cathode, and an electron gun shoots electrons down the tube and onto a charged screen. The screen is coated with a pattern of dots that glow when struck by the electron stream. Each cluster of three dots, one of each color, is one pixel. Certain colors, such as white, require all three dots to be charged, and are energy intensive to display. Other colors such as black require no additional energy to produce and thus consume the least out of all the colors. Latest technologies like Plasma displays use the same three dots of phosphors per pixel technique as CRTs and thus colors are produced in the same way.

Therefore power consumption for CRT and PDP monitors is primarily a function of the user's color settings and desktop graphics, and any given CRT monitor requires more power to display a bright screen than a dark one.

Data collected from the experiments done by us showed that a difference of about 12W was obtained switching from a white to a black screen background depending upon the size and intensity level of the monitors.

This forms the basis of our solution. Our solution advocates the usage of those color schemes which are energy efficient. At individual level saving may appear negligible but idea when implemented at large level, considerable amount of energy can be saved which would have been wasted otherwise. This solution may be implemented at different levels.

4. At Individual Level

4.1 Changing the Web browser settings

We can use browser option to change the color scheme for some or all the pages one views. The advantage to this approach is that significant energy savings can be realized, as all incoming web traffic is converted to a low-energy format. There are several alternatives depending on the browser and/or operating system in use.

Firefox- Users of the Firefox web go to 'Tools > Options > Content > Fonts & Colors > Color in Firefox and change the default color background and text to any desired color; users who implement this option should uncheck the box that says "Allow pages to choose their own colors, instead of my selections above".

Internet Explorer- In Internet Explorer, go to Tools > Internet Options > General > Appearance > Colors to alter your personal color scheme. You will also need to go to Tools > Internet Options > General > Appearance > Accessibility to override the default color options on the pages that you visit.

4.2 Changing the text editors settings

People spent a lot of time in doing text editing, especially in offices, companies, colleges and universities. But almost all the text editor use white color as background, however, energy can be saved by changing background color to black.

For the ***MS Word 2003***- Go to the Format menu and select background.

For the ***MS Word 2007***- Go to page layout and select background color.

4.3 Changing themes of operating system

We can also change the themes of our operating systems to achieve the same target. Using the themes based on black color will reduce the power consumption. For Windows XP/Vista this can be done by right clicking on the desktop and the selecting the properties. Then from the themes tab themes can be changed easily.

4.4 Changing the wallpaper

We can also use the wallpapers with predominant black color.

4.5 Changing the screen savers

Screen savers were made to prevent images from being "burned" into the monitor. Newer monitors don't really need screen savers anymore. In fact, a screen saver will likely consume more electricity than just leaving the computer running idle, because it consumes processor power and graphics processing power to display those lovely graphics.

5. At Website Level / National Level

By changing the color schemes of particular web sites like Google, Yahoo, Myspace, Twitter, Facebook, Linkedin, Orkut etc. which have very high traffic, huge energy savings may be achieved. This approach relies on the websites to change their primary color scheme. For e.g. Google is said to attract about 200 million queries per day. Now if we assume the time taken for a query to be completed as 10 seconds even then it will amount to huge power savings if google changes its home page to white text on black background. Color schemes of incoming web traffic can also be modified at a high level, such as the corporate or country level. In this case, an entity with a large number of CRT monitors might intervene on their user's behalf to convert the color codes as they travel through the network, thereby producing a uniform color scheme for the entity as a whole.

6. Evaluation

TABLE 1

Experimental Parameters

Monitor used (CRT)	LG 700S
Size (in inches)	17
Resolution	1024 x 768
Brightness (out of 100)	65
Contrast (out of 100)	88

Method of experiment

The monitor was connected to watt meter and power supply was given.

Step 1- Firstly screen was made to display only black colour completely and values were noted down from the watt meter.

Step 2- Then screen was changed to all white and readings were noted down again keeping all the other conditions similar.

Thus result shows a difference of about 12 W between the cases when screen were completely black and completely white.

TABLE 2

Results

Wattmeter reading	All White	All Black
Reading 1 (Watt)	71	59
Reading 2 (Watt)	71	59
Reading 3 (Watt)	72	59
Reading 4 (Watt)	72	60

Test case- Now we took a college as the test case and collected some data about the number of CRTs used in various labs and

then calculated how much energy can be saved. During calculations the difference was further averaged to be of 10 W because when actual working will be done on the systems then screens will not be completely white or completely black. Results obtained are as shown-

Total CRTs = 536
Total CRT's working =536

TABLE 3
CAMPUS DATA FOR CRT

Lab number\name	Number of CRTs	Avg. daily use (hours)	Size of monitor (inch)
Graphics	30	3	17
Advance OS	30	3	17
Programming	30	5	17
CAD\CAM	22	3	17
DSP\CAD	30	3	17
PLC Mat Lab	22	3	17
Internet Lab	41	5	17
MIS Lab	37	3	17
Web Tech	30	3	17
OS Lab	37	3	17
Main Lab	4	6	19
S01	45	3	17
S02	45	3	17
T301	45	3	17
B Pharma Lab	40	5	17
Biotech Lab	35	5	17
Administration	8	5	17
Library	5	5	17

Total working hours on all CRTs in a day = 1938

Difference if above scheme is applied = 10 W
Savings in a day = 1938 x 10 = 19.38 KWH

7. LIMITATIONS OF OUR SOLUTION

i) One of the major limitations to this solution is that it is applicable for CRTs only because the TFTs have no change in the power consumption irrespective of the color being displayed.

ii) Secondly people find it difficult aesthetically to work upon a black background. Usually colours are preferred over a simple black and white interface.

8. END SECTION

8.1 CONCLUSION & FUTURE WORK

It can be easily inferred from the data given above that a lot of energy can be saved by just following some very simple steps. Thus, if it is applied on large scale some very significant effects could be seen.

Some further research can also be done with proper instruments of high precision so that the actual difference is obtained with no experimental errors.

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