# A Regenerative Feedback Approach to Green Computing

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*Abstract* — In the present world we are facing lot of electricity problem, lack of natural substances, depletion of fossil fuels etc., hence we should think of acquiring maximum with the limited energy resources. Green computing is the term used to denote efficient use of resources in computing .This paper mainly deals with a regenerative approach towards green computing, to enhance the power backup of battery in the laptops. This paper also throws light on regenerative technique (the heat generated by the processor is utilized) and made to harness energy.

*Keywords*— Amplifier, Green computing, Piezomaterial, Sensors.

## I. Introduction

Green computing is very much related to other similar movements like reducing the use of environmentally hazardous materials like CFC's promoting the use of recyclable materials, minimizing use of non-biodegradable components, and encouraging use of sustainable resources. All Mobile systems (portable systems include laptops) have become increasingly more powerful, but they depend on a battery, which can only power it for a limited period of time. To extend the battery life, we need to reduce system power without compromising performance. This has motivated newer portable computers to feature components that support several power modes. Examples include processor Dynamic Voltage Scaling (DVS), low power modes in RAMBUS DRAM, wireless card radio power modes, and others. Moreover, there is a big research initiative to exploit these component level power management features for reducing power consumption. For instance, the GRACEOS scheduler sets the CPU speed based on application demand [1], power aware page allocation puts active pages on a minimal set of memory chips [2], and cooperative I/O queues hard disk accesses to maximize the standby time [3].

This paper presents a new approach towards green computing i.e., regenerative feedback approach, the power utilized by processor is given out as heat, this method converts back that heat which is generated by processor into electrical energy and feeds the other part such as USB ports etc

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A part of energy supplied to the processor is converted back to electricity. With the help of piezo materials which can be fitted to keyboard and mouse can also generate electric pulses which helps to charge the battery of the laptop thus it helps in longer powering for laptops without compromising the performance.
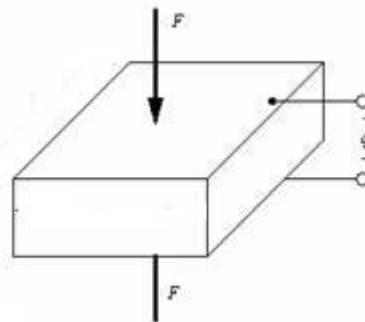
## II. Behavior of piezo-materials



Figure 1: Force applied to piezo material

Piezo electricity is the ability of some materials (quartz) to generate an electric potential in response to applied mechanical stress (pressure). The piezoelectric effect is caused by the appearance of electric polarization in a material that strain under stress as shown in figure 1.

Piezo sensors are used to convert mechanical movements, such as force, vibration, acceleration or pressure, into electric signals. Piezoelectric elements are widely used in a variety of sensors such as accelerometers, contact mic's, and ultrasound transducers. Piezoelectric sensors can be used as force-sensitive switches, threshold detectors, analog pressure sensors etc. [3].

## III. Origin of Green Computing

In 1992, the US Environmental Protection Agency launched Energy Star, a voluntary labeling program which is designed to promote and recognize energy efficiency in monitors,

electrical equipments, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. The term "green computing" was probably coined shortly after the Energy Star program began. Concurrently, the Swedish organization TCO Development launched the TCO Certification program to promote low magnetic and electrical emissions from Cathode Ray Tube-based computer displays [4].

## IV.    Reasons to Green IT:

As business ramps up, sustainability is top of mind for IT managers. It is now a major focus for organizations, and executives are considering how it pays, how it doesn't and where it counts to make changes. In 2007, many discovered that sustainable practices can strengthen their reputation, improve employee morale, deliver cost savings, and benefit the environment. Reducing PC energy waste. Below are Kevin Klustner's President and CEO, Verdiem top 10 reasons why greening the IT department is an important starting point toward sustainability.

1. It saves money (a lot of money): PC power management software can cut energy costs by $20-60 dollars per PC, which can translate to six and seven-figure annual savings for large enterprises. For many organizations, this can mean a 5-15 percent reduction in overall, organization wide energy consumption.

2. It's the right thing to do: 15 PCs can generate as such carbon emissions as a mid-size car each year. Implementing effective PC power management strategies in your enterprise provides a way for your business to do its part in helping the environment.

3. Sustained growth requires sustainable operations: The average PC consumes 588 kilowatt-hours of electricity per year, and wastes almost 400 kWh of that by running at full power when not in use. Putting a computer in sleep mode during inactive times can cut energy use on average 60-70 percent and up to 90 percent in aggressive scenarios. As your company grows and as demands on your IT and PC networks increase, getting control over energy use will become an important advantage [7].

4. It's not easy being not green: In recent years, news coverage has exposed deep holes in many company sustainability initiatives, raising concerns about high cost infrastructure changes and the validity of overseas carbon offset programs. Replacing office equipment can be time and cost- intensive. But making your existing equipment more energy-efficient is a fast and easy process that pays off

within months, and makes it difficult being not green.

5. Lower exposure to energy prices: Energy sales are expected to grow 50 percent worldwide by 2030[8]. By reducing the amount of power required to operate your business, you'll mitigate risk from factors well outside of your control.

6. Energy-efficient IT is high performance IT: IT equipment can account for nine percent of all Energy consumed by businesses- the third-largest source of power for the commercial sector. Putting power management policies in place is the easiest way to control power consumption across your network.

## V.    PROPOSED REGENERATIVE FEED BACK PROCESS

Micro processor or the processor of the system gets the energy(voltage) from the battery of the laptop, and does the computing work, apart from that it also gets heated up. This heat is thrown away by CPU fan, which acts like exhaust fan, which takes out the heat from the CPU. In this regenerative process we convert the processor heat i.e., heat which is thrown out to the heat sink, to electricity with the help of piezo sensor/piezo material. Piezo material is placed closed to the motherboard such that maximum heat is incident on piezo material before letting hot gases to the exhaust fan. Piezo materials convert the heat change/temperature change to the corresponding electricity. This electricity is amplified and given to some application. Hence the energy required by the other application or hardware is not taken by the battery it is the energy which is a feedback from the waste heat produced by the processor. This energy (voltage) which is obtained by the piezo generator is amplified and given to cell of the battery. Hence the cell in the battery gets charged there by battery backup of laptops increases Thus it is a regenerative process that the energy spent by the battery to the processor, is again regained to some extent by using piezo materials.

## VI.    FLOW DIAGRAM OF THE PROPOSED METHEDOLOGY

Some applications or hardware devices such as USB port or any other device which requires a constant current after cpu gets switched on can be connected to the output of the piezoelectric materials. Since the device which is connected to the output of piezo material is not connected directly to the battery, it can save battery's energy hence the power back up of the laptops can be increased. Also the output of the piezo material can be given to battery to charge the battery (feed

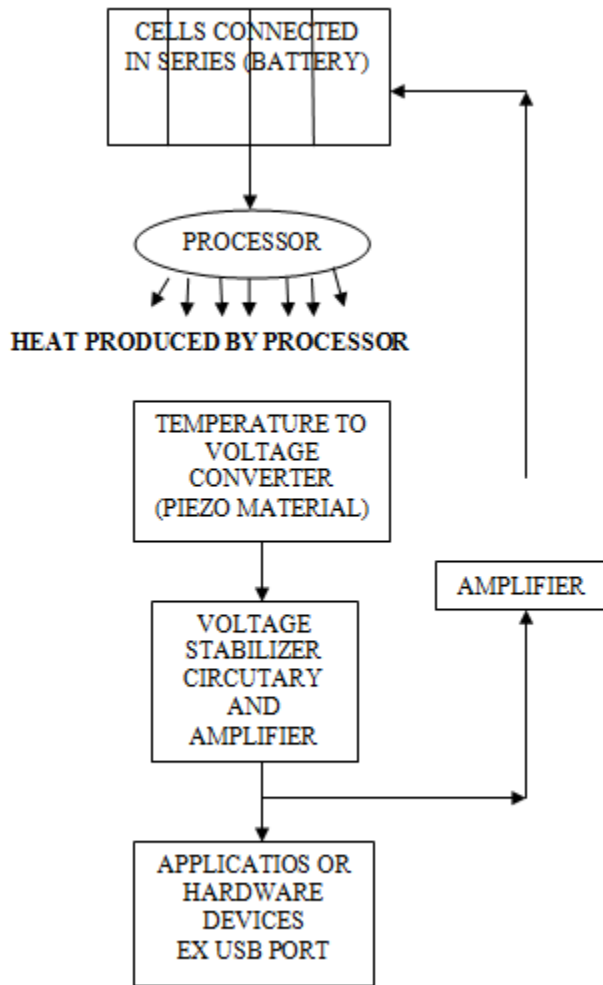back approach).this can be done using an amplifier circuit in between) as shown in figure2.



Figure 2: Regenerative process's flow diagram

Laptops battery consists of cells of lower voltages, these cells (each of 6v) are interconnected in series to produce large voltage of (12V-18.5V) depending on the design. The amplified output of the voltage coming from piezo material is always less than the voltage of the battery [as a whole]. so the battery cannot be charged as the charges flow from higher potential to lower potential. Therefore the cell in the battery is charged not the battery as a whole. Since the cell is of lower voltage it can be charged. By this technique a regenerative feedback can be used to charge the laptops battery.

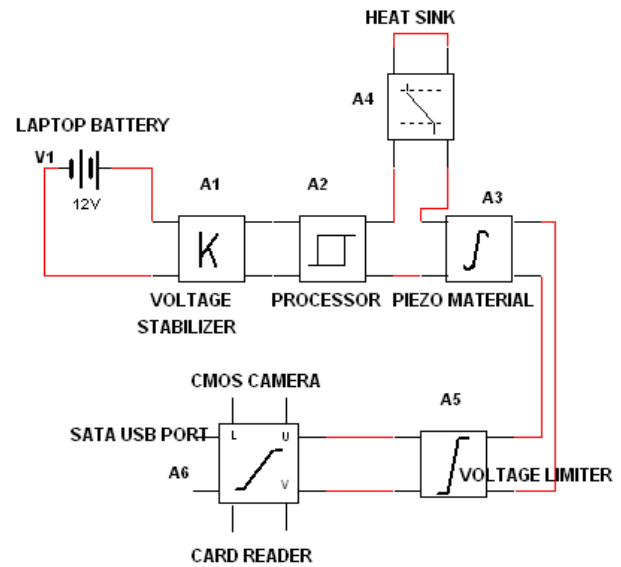## VII. Circuit diagram of the proposed regenerative process



Figure 3: Circuit of regenerative process

Processor and other components such as monitor hard disk etc., gets power from the battery .in the normal laptops all the power required components are directly connected to system battery. But by using the above methodology as shown in figure 3 Some components such as CMOS camera, Bluetooth and USB ports can be powered by indirect way as shown in figure 2.this helps laptop battery to power the system for longer period of time.

As shown in figure 1 the piezo material placed close to the processor (figure 3-A3) will generate electricity in accordance with the temperature change in the processor. The excess heat after generating electricity is sucked by cpu fan an heat sink.

The voltage from the material is sent to voltage limiter circuit to limit the voltage and is then sent to the hardware devices such as CMOS camera, Bluetooth device or the USB port and indicator lights, cpu speakers and to cpu fan.

If some application requires high voltage then in between piezo generator /sensor a voltage amplifier circuit is included so as to increase the voltage and then it is sent to that hardware device.

## Conclusion

Green computing represents a responsible way to address the issue of global warming .Today in the United States there are over 200 million computers in use in business and residential settings. The annual national energy use of computers and their associated monitors is approximately 85

billion kWh per year, or approximately 2.8% of the total US electricity use. Due to their portability, improved performance, and reduced purchase costs, laptop computers are becoming an increasingly popular choice for residential and commercial consumers alike. Laptops employ the latest developments in computer technology due to the need to prevent overheating and to maximize battery life. The objective of this green technology is to reduce the carbon emission and also usage of energy in efficient manner. In this we also discussed why we need green IT and also provide a design to increase battery backup of laptops.

## *Acknowledgement*

## *References*

[1]    Yuan and Nahrstedt. Energy-Efficient Soft Real-Time CPU Scheduling for Mobile Multimedia Systems,SOSP 2003.

[2]    Lebeck, Fan, Zeng, and Ellis. Power Aware Page Allocation, ASPLOS 2000.

[3]    Shreyas.s,Sahana s,Deepak.g CiiT International Journal of Wireless Communication, Vol 4, No 13, August 2012

[4]    Green IT'-IBM technology services

[5]    Green Technology and ServiceDr. Jen-Yao .

[6]    ChungIBM T. J. Watson Research CenterYorktown Heights, New York

[7]    "EPA Announces New Computer Efficiency Requirements". A report regulated Ernesta.by Jones .

[8]    Report of green computing task group green computing and the environment .

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Regenerative approach is a kind of methodology wherein the outgoing heat radiation is converted into useful electricity.
Green Computing Helps For Sustainable Development.

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