International Journal of Computing Science and Information Technology, **2018**
ISSN: 2278-9669, April 2018 (http://ijcsit.org)

A Study On Heat Generation Effecting The Performance Of Electronic Gadgets – Designer Challenges

Rashmi B [1].
Sindhi College,
Bangalore, India;

Akilandeswari R [2].
Sindhi College,
Bangalore, India,

Received January 2018

Abstract

Heat generated in electronic devices is one of the biggest challenges in Electronics industry. Over-heating causes significant reductions in the operating life of a device and leads to device failure. Here I am discussing the cause of heat generation and possible remedies for the problem.

Keywords: Heat, Electronic gadgets

I. INTRODUCTION

Heat generated in electronic devices is one of the biggest challenges in Electronics industry. Heat may be generated because of continuous usage of the device, or overcharging the gadgets, performing highly complex task or due to various other reasons.

Over-heating causes significant reductions in the operating life of a device and leads to device failure. Devices such as cell phones are becoming increasingly complex, with larger screens and more functional capabilities, which makes heat dissipation even harder. [2]

II. CAUSE OF HEAT GENERATION

Heat generates from electronic circuits as they consume electric power. Heat generates in a gadget consumes battery power. Thermal radiation is just the by-product of electromagnetic movement within millions of circuits, and the internal resistance it encounters.

Electricity powering the device is the simple reason why device becomes hot. Even LEDs produce it, though it’s minimal because the amount of electricity needed to function is low. Naturally, the volume of electricity needed for each component varies depending on the operations being performed, but there are some consistently with higher temperature output.

Central Processing Unit (CPU), naturally generates heat as it carries out complex algorithms, similarly Graphics Processing Unit (GPU), which typically handles 3D imaging for display. Gaming can result in higher temperatures, especially as they often require GPUs to carry out complicated calculations (in many instances, the GPU can generate more heat than the CPU). Hard disk drives can also contribute to heat generation, especially when copying large files.[1]

Room temperature also affects the internal working of electronic device. High room temperature can reduce device’s performance as it is also affected by its internal temperature.

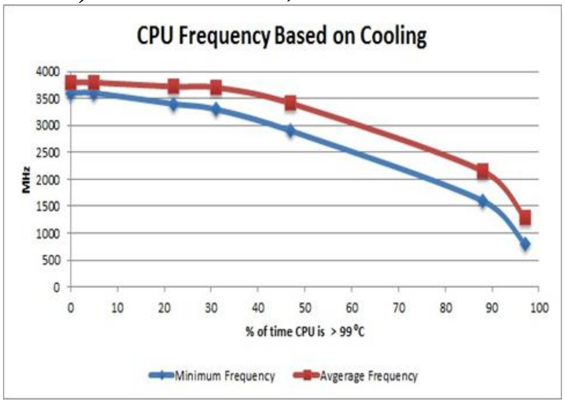
Dissipated heat need to be transferred to the exterior of the gadget to maintain the temperature in appreciable limits. Thermal management section of any electronic system will maintain this issue which is very complex and multi-faceted.

There are several techniques for cooling including various styles of heat sinks, thermoelectric coolers, forced air systems and fans, heat pipes, and others.[3] In cases of extreme low environmental temperatures, it may actually be necessary to heat the electronic components to achieve satisfactory operation.[2]

III. EFFECT OF FREQUENCY ON HEAT GENERATION

Modern CPUs are able to adjust their operating frequencies through a number of technologies. CPUs also have extremely robust thermal protection. If the CPU starts operating above the CPU's thermal limit it will begin to reduce the frequency in order to prevent catastrophic

failure. Therefore once we reach certain temperature, we will no longer be getting the maximum performance from the CPU because it will be busy protecting itself.[4]
We can expect full performance from the CPU as long as we keep it below the maximum temperature (Eg: 100 °C). At the same time, even if the CPU occasionally



hits that maximum temperature there will not be any drop in the performance until the device spends a significant amount of time (more than 20% of the time) above maximum temperature.
The most important part in a processor is the **transistors**, the electronic devices that act as switches in order to construct logical gates. These logical gates put together in different combinations; they form units capable of performing arithmetic and complex logical operations.
The speed at which such an operation can be performed is, limited by the frequency at which the transistor can switch from on to off, and still perform without failure. Since transistors are the building blocks of the logical gates, this switching frequency also limits the operating speed of our processor.
So, if we feed our processor with one input signal per second and the processor performs our operations error-free, we say that the processor is clocked at 1 Hz. In other words, the clock speed of the processor is a kind of certification telling us how often we can give it instructions and still have failure-free operations. Looking at it the other way around, a processor with a clock speed of 3 GHz allows us to feed it with 3 billion operations per second, and we can still expect it to perform as predicted. [6]

More operations per second mean that we can get more work done per unit time. For the user, this means that the programs on the computer will run faster and this without doing much modification to the code.
The transistor count of a processor is the number of transistors that the processor is equipped with. Since the CPUs stay roughly the same size, the transistor count is directly related to the size of the transistors.

Thermal losses occur when we are putting several billions of transistors together on a small area and switching them on and off again several billion times per second. The faster we switch the transistors on and off, the more heat will be generated. Without proper cooling, they might fail and be destroyed. One implication of this is that a lower operating clock speed will generate less heat and ensure the longevity of the processor. Another severe drawback is that an increase in clock speed implies a voltage increases resulting in high power dissipation.

Through the application of multi core computing we can get more computing power out of more transistors without increasing clock speed. The overwhelming benefit of multi cores can be derived from the following reasoning: When cutting down the clock speed by 30%, the power is reduced to 35% of its original consumption, due to the cubic dependency yet, computing performance is also reduced by 30%. But when operating two compute cores running with 70% of the original clock speed, we have 140% of the original compute power using only 70% of the original power consumption (2 x 35%). Of course, to reach this type of efficiency, we need to program the parallelization of the process code to perfectly exploit both cores operating at the same time.

This step not only decreases the power the processors require by reducing the current flowing through the transistor to almost zero when it is in the off state, but it also allows as much current as possible when it is in the on state. Therefore, it will increase the performance.

IV. REMEDIES TO REDUCE THE HEAT GENERATION

Multi core is the only alternative for further performance gains and less power consumption, but it comes at the cost of parallelism in the software. This is one of the reasons why an 8-core, lower clock speed 2.6 GHz processor can solve many of complex calculations much faster than a dual core with a higher clock speed of 3.5 GHz.[5]
Since Device designers have to manage several components that consume a lot of power, such as the display, DRAM (dynamic random-access memory) chip, and power amplifiers. So it is essential for device makers to reduce display subsystem power through innovative techniques.
They are being challenged to make the right tradeoffs among these specifications, keeping in mind the overall effect on the system.
Adding to those problems is the current trend of manufacturing integrated circuits (ICs) for greater functional densities. Simulations have shown a 10°C rise in temperature to potentially double an IC chip's heat density and thus reduce performance by more than one-third. [2]

As electronic devices get smaller, engineers and designers are faced with the growing challenge of keeping up with the need to optimize processing speed within a shrinking form factor. Faster processors necessitate increased power consumption, which generates heat; and smaller form factors necessitate greater miniaturization of the implements used to disperse that heat.

Heat dissipation must be proportional to the power dissipation of a given device. Power dissipation is the amount of electricity wasted by a Even though the processors in cell phones, for example, often use just a few hundred milli watts of electricity, much of this is simply lost to heat.

One real time example for adverse effect of overheating in electronic gadgets is cell phones. Cell phones may reach high temperature if we charge continuously, or if we are using high definition applications like gaming etc. If we try to analyse these things to some extent then we need to understand about the batteries that is used in cell phones.

Cell phones use lithium ion battery packs for their power, and most lithium ion batteries is highly flammable. It is known for years that lithium ion batteries pose a risk, but the electronics industry continues to use the flammable formula because the batteries are much smaller and lighter than less-destructive chemistries. So usage of this kind of batteries makes the device lighter and compact.

If the battery short-circuits say, by puncturing the incredibly thin sheet of plastic separating the positive and negative sides of the battery -- the puncture point becomes the path of least resistance for electricity to flow. It heats up the liquid electrolyte at that spot. And if the liquid heats up quickly enough, the battery can explode

V. CONCLUSION

To enhance the effectiveness of the designs based on performance, power, and thermal parameters designers has to concentrate on consumer desires, needs, the way they are using their mobile devices today as well as in the future. As these demands increase, the challenges of beating the heat produced by increasingly dense printed-circuit boards continue to emerge.

Multiple microprocessors, are reaching into the gigahertz range of operation, which makes cost-effective thermal management. We can reduce the number of components by making use of currently available integrated circuits (ICs) for greater functional densities. Multi core is the only alternative for further performance gains and less power consumption, but it comes at the cost of parallelism in the software.

REFERENCES:

[1]http://www.makeuseof.com/tag/how-heat-affects-your-computer-and-should-you-be-worried/

[2]Cooling Electronic Devices –Pelonis Technologies – Technical note

[3] OSHA Technical Manual

[4] Sorin Witzman, Tristano Nicoletta, Bonnie Mack Enhanced heat transfer for electronic devices operating inside enclosures

[5] Masud Behnia, Luke Maguire and Graham Morrison Cooling Problems and Thermal Issues in High Power Electronics – A Multi-Faceted Design Approach

[6] Thermal Management in Electronic Equipment Feb 2010