Highly Configurable Computing Unit
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ABSTRACT

E-waste is a serious problem that we face today and several processes and techniques that try to extract usable material from them are already being explored; but, these techniques and processes attempt to only solve the problem of E-waste that has already been created - The heart of the problem lies in reducing E-waste to be created by future technologies. The concept that this paper proposes is that of “Highly Configurable Computing Units”. The idea here is to develop a computing unit that is highly configurable, sturdy and has a very good lifetime. The CPU chassis has lots to offer - customizable from top to bottom, made of recyclable material, aesthetic looks and the most important feature: the ability to adapt to present day technology. Consumers merely change the outdated components instead of the entire computer as a whole. Hence the key requirement of the HCCU [Highly Configurable Computing Unit] is to facilitate the easy replacement of components and ensure system stability after the change.

Keywords: E-waste, Future Technologies, Configurability, Customizability, Replacement.

1. INTRODUCTION

According to a survey [Commissioned by 'Crucial' - A manufacturer of RAM chips] carried out in the United States, United Kingdom and France in January 2011, it was found that users replace their computers every four and a half years. And the main culprit was - outdated memory capacities and hence the self-serving study is being used to convince people that a RAM upgrade can inject new life into an aging machine.

Crucial Technology, a brand used by semiconductor manufacturer Micron Technology which in turn is best known for producing many forms of semiconductor devices.

Fig 1: Logo of Crucial Technology

There is components in the computer that are being improved upon every passing year and yet, there are components that are still relying on decade old technologies. This can be accurately demonstrated with the fact that Primary-Memory technology is always advancing [from the DDRs to the DDR3s] but Auxiliary-Memory technology has been stagnant [considering Magnetic Disks are still very widely used]. Hence there exists an imbalance in the evolution of computer components and thus replacing the computer as a whole is not justified. Replacing only the outdated/repaired component is the logical and economical choice.

The HCCU [Highly Configurable Computing Unit] attempts to address the problem of E-Waste in a two-fold manner:

a. By Reducing The Amount Of E-Waste Generated

Replacing only the outdated components, instead of the whole computer, attains this.

b. By Using Environmental-Friendly Materials

The use of eco-conscious and environment-friendly materials reduces the amount of hazardous E-Waste being generated each year.

2. EXISTING SYSTEM

All existing systems are modifiable/upgradable to a certain extent, but there are some deterrents that either prevent successful up-gradation or make the process of up-gradation cumbersome. Some of the deterrents are:

a. Cabinet Issues

Most cabinets are bulk produced and are not customized to suit individual requirements. Some cabinets are too cramped to facilitate easy replacement of components.

b. Wiring

Even if the cabinet poses no hindrance, the basic wiring involved in the replacement causes panic to the novice user and calls for expensive technical support.
c. Data Loss

After going through tricky cabinet designs and messy wiring, the user is presented with a new problem when replacing memory components – Data Loss. The user is not prepared to handle such problems and the computer system does not offer support by default.

3. PROPOSED SYSTEM

The proposed HCCU [Highly Configurable Computing Unit] attempts to by-pass all the problems discussed above [referring to the existing systems].

This paper provides a model that includes preferences in motherboard type, modifications in basic architecture, modular cabinet design, novel cooling technique, and choice in materials used – to produce a Highly Configurable Computing Unit that facilitates easy up-gradation and is environment-friendly.

3.1 Key Concepts

These are they key elements that help us define the model for a HCCU.

a. Flipped-Out Architecture

This is the backbone of the HCCU, and the architecture refers to the concept of external-placement of the internal (traditionally) computer components. Thus facilitating easy reach to the replaceable components.

i. Non-Integrated Motherboard

The Flipped-Out Architecture is characterized by the use of a non-Integrated motherboard.

The Use of Non-Integrated Motherboard enables the placing of components on a more spread-out basis. Thus helps us in realizing the goal of easy reach to components.

Easy to reach components = Easy to change

The term "integrated" refers to the computer peripherals. Integrated motherboards have things such as the sound and video controllers as well as Ethernet embedded on the motherboard. Non-integrated motherboards only have the essentials for the motherboard, while things such as video and sound must be installed separately.

ii. Components To Be Placed Outside

The following are components that are to be placed outside (out of the motherboard)

- RAM Board
- GPU

As discussed earlier, RAM and GPU upgrades are the most sought after; hence the RAM boards and the GPU unit(s) must be easily accessible.

iii. Requirements

The realization of the Flipped-Out Architecture requires a novel CPU Casing/Housing design to:

- Achieve expected level of ease for access to components
- Address issue of increased heating
- Achieve design/aesthetic goals

b. Modular Casing

A Novel casing technique is essential for the realization of the ‘Flipped out Architecture’. The CPU casing/cabinet is partitioned into 2 modules and it features triple openings:

- Left Side opens to the side of the motherboard containing the Processor and RAM Board.
- Right Side opens to the side of the motherboard containing the GPU.
- Front Side of the cabinet houses the Optical Drives, “Tool-Free Hard Disk Bays”, etc.

The Cabinet also has Audio Jacks, Ethernet, USB and other ports mounted on the top and the motherboard is placed at right angles to the base, to enable the dual openings.

i. Manufacturing Requirements

The cabinet is preferably cast in lightweight metal (Aluminum/Aluminum-Alloy) to satisfy the requirements of a rigid design – that permits 3 open-able hatches. Mono coque construction (or Uni body-design) would fit the manufacturing requirements perfectly.

Monocoque is a construction technique that supports structural load by using an object's external skin, as opposed to using an internal frame or truss that is then covered with a non-load-bearing skin or coachwork. The term is also used to indicate a form of construction in which the framework and the outer body form a single unit.
ii. Tool-Free Hard Disk Bay

This is a trend that is soon catching up, and it refers to the situation where no tools are required to replace the hard-drives (HDD/SSD). The hard-drives are placed into plastic/metal outer jacks that just slide into bays, enabling easy installation.

iii. Design Requirements

Since the HCCU is seen a product with a long life, design aspects are given much importance. The key requirement here is to make sure the HCCU does not look old/outdated as the years pass by.

c. Extended Cooling

Since, the CPU Casing is partitioned – it must be ensured that both the partitions are cooled effectively. Efficient Cooling is a pre-requisite because

- Non-integrated Motherboards produce more heat
- The GPU unit produces lot of heat, and that partition might heat up.

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**Highly Configurable Computing Unit**

A. Left Side View
B. Front View
C. Right Side View
G. Top View

D, E - Openable Hatches
(made transparent to enable inside view)

F. Cabinet Base

1. CPU
2. RAM Board
3. Cooling Fans
4. GPU Unit
5. Power Button
6. Audio Jacks
7. Other Ports
8. Openable hatches for Auxiliary Memory
   (Hard Disk Drives, SSD, Optical Drives)

**Fig 2:** Schematic Diagram for the HCCU

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The CPU may be liquid-cooled, depending upon the user’s requirements and preferences.

Since the Motherboard is placed perpendicularly, an up-venting airflow situation is created and a suggestive cooling fan placement is given below:

![Fan 3 Diagram]

**Fan 3**

**i. Cooling Fan placement**

This suggestive model requires 3 fans, where 2 are used for the purpose of air-intake and the other is used as exhaust. The 2 air-intakes are placed on either sides (below the opening hatches) and the common exhaust is placed on top of the cabinet – this takes care of the up-venting airflow situation.

**d. Disk Cloning**

[6]

Following the ‘Crucial’ survey – Outdated Memory Capacities are the primary reason for computer replacement; this now leaves the problem of loss of user data to be taken care of, when the hard disks are replaced. Disk cloning software is pre-installed on the primary storage unit to help the user experience a trouble-free transition to the newer memory unit without the loss of a single byte.

Cloning creates an identical copy of your hard drive at particular time. This copy, which is stored in a single file called an image file or disk image, can be placed on a separate disk partition, a different drive, or on removable storage media. With the image file, one can easily restore the entire user data and files that the hard disk to be replaced contains.

The software for disk cloning is called Disk Imaging and it resembles data back-up software, but there is a major difference between the two. Cloning operates at the disk or partitioning level, not the file level. Cloning Software is designed to produce a purely static image of the system.

The image file created by the cloning software contains all details of the hard drive and includes all files, no matter what their attribute settings (hidden / read-only etc.)

**e. High Recyclability**

Since the main objective of the HCCU is to reduce the amount of E-Waste - it must be highly recyclable and the production of a HCCU must be environment-friendly.

The High-Recyclability is achieved through a two-fold technique:

- Reducing amount of material used, by increasing lifetime of product
- Elimination of hazardous compounds in manufacturing
i. Greener Materials

The HCCU cabinet is cast in aluminum, which is highly recyclable and also ensures very long lifetime – thus cutting down on the amount of material used. Along with eliminating hazardous compounds and use of recyclable aluminum – other environmentally conscious materials like recycled plastics and biopolymers are used in the design of the unit.

ii. Responsible Manufacturing

One of the environmental challenges facing our industry today is the presence of toxic substances such as arsenic, brominates flame retardants (BFRs), mercury, phthalates, and polyvinyl chloride (PVC) in products. The HCCU manufacturing strives to eliminate these from their manufacturing processes.

4. RESULTS AND DISCUSSION

The HCCU paves the way for the future of home computing, where environmentally conscious consumers can enjoy the privileges of the modern day computing without placing a burden on the sustainability of the environment – all this and the added benefit of being ‘future-ready’.

Adaptability is the key to survival, and in this case adaptability keeps the user from changing his/her computer system and eliminates the kilograms of E-waste that the machine would have normally generated (if discarded). The survivability of the HCCU concept depends on two key factors:

- Acceptability by the Major PC Manufacturers
- Level of Eco-Consciousness among computer users

a. Acceptability by the Major PC Manufacturers

With over 88 Million shipments of Personal Computers shipped each quarter (a Q1 2011 estimate), computer manufacturing is a very lucrative business and almost all of revenue is generated from sales of ‘new’ units. And the manufacturers would do anything to convince the consumer to change his/her computer system, citing upgraded technologies. The HCCU in this regard would mean a substantial change in the revenue model – As, there would a higher (relative) initial cost of purchase of the Unit and lower costs of subsequent replacement. The replacements would normally fall under ‘after-sales’ division and this division is never seen to be a profit-generating one. The ‘after-sales’ division is merely a tool to increase brand reputation and offer technical support and service. The survivability of the HCCU depends critically on the acceptance of the concept by the PC manufacturers and on the fact if they are willing to take the risk of changing the revenue-model.

b. Level of Eco-Consciousness Among Computer Users

Another major selling point of the HCCU is the presence of eco-consciousness among the PC users. Since, the message of sustainable-development is spreading on a rapid basis and everybody wants to do his or her bit towards the environment – the HCCU is a practical concept. The question is whether, the users would pay the extra premium for the sake of environment sustainability.

5. CONCLUSION

As discussed above, HCCU if seen as an offering to replace the entire number of traditional PCs shipped – causes a major re-shuffle of the PC manufacturer’s revenue models. Citing the potential risks of revenue-loss the manufacturers would never accept the product. Instead, the HCCU initially should be positioned as a premium offering (justifying the premium pricing), where willing customers pay the extra price for guilt-free* computing.

It is observed that there exists a gradual decline in the operating profits of PC Manufacturers; this is due to stiff competition from Apple Inc. and its Macintosh range of computers. PC manufacturers have now recently started investing in aesthetic design to match the performance in their products to take Apple Inc. head on. And the HCCU sees viability in this competition between the Mac and the PC – as the HCCU by default scores in both the spheres of aesthetics and utility. If accepted and developed by the PC community, the HCCU is a strong product to gain back lost ground from Apple.

Also, there is a rising trend of increased eco-awareness among the masses and this has resulted even in energy rating for electric appliances. HCCU can capitalize on this trend and gain a few customers who don’t mind spending a few extra dollars – which in the long run would be more economical and more importantly helps in preserving the sustainability of the environment.

Guilt-free* - without the guilt of potential E-waste being created

6. FUTURE ENHANCEMENT

This paper addresses only the E-Waste generated by the CPU, and not the peripherals; But, a lot of E-waste is generated from the peripheral units such as monitors,
printers etc. which contain highly toxic substances such as lead. Hence a future enhancement for this project would be in finding novel ways to reduce E-waste generated from the computer peripherals.

REFERENCES


