Communication Skills 1
Assignment 2: Extended Abstract
Alumno 1: Federico Parisi
Alumno 2: Jonatha Oliveira de Matos Reis

SFF Computers: Because size matters and sometimes smaller is better

1 Introduction

The advances in electronics and miniaturization allowed us to move from computers that were once as big as an entire room to portable devices that we can carry in our pockets [1]. Naturally, the applications for these computers increase in complexity as well, and every computer advance is followed by question about how far we can push the system, how small we can build it and what is the next big break through. Designers, researches, or anyone with a need for a powerful computer will likely have to face the decision of either have a powerful or a portable system.

This choice (powerful *vs* portable) often comes from the idea that a powerful system means a computer with a great performance, usually a desktop computer, that has big dimensions, is heavy and is probably going to stay in the same place. The portable system, in the other hand, would be a small laptop computer, that can be either very light but weak in terms of performance, or is going to be robust but too heavy to be carried for too long and can be extremely expensive. The small form factor (SFF) computers come in as the middle ground between these two opposite needs, being small enough to be portable but still maintain the same levels of performance as a desktop.

2 What is a SFF computer

A SFF computer is understood as a desktop computer designed inside a case under 20 liters in volume. Their design should be capable of holding the same features as a normal desktop computer, keeping the same efficiency and without having a big difference in cost.

The SFF computer main component is definitely the case itself, with each case format having its own characteristics and classification. It can be:

- Home Theater Style (HTPC): These type of cases are thin in width and tall and lengthy [2]. They draw their name from their similarities with the living room home theaters. It is also common to use this type of computers in the living room as an alternative for game consoles.

- Cube Style: As the name suggests, these types of cases are shaped like cubes. They have the advantage of being able to hold normal size coolers, but because of the their cubic shape, they are not too appreciated for those that care about the aesthetic of the computer.

- Sandwich Style: This is one the most recent styles of cases, becoming famous with the first Dan A4 case [3]. It has this name because of the way the motherboard and graphics cards are positioned inside the case, being side by side and usually separated from each other by a physical wall. This particular design is one of the most famous ones, because the heat generated by the graphics card and CPU is pushed easily outside the case and do not get trapped inside (which can happen for the cube style), while also maintaining a format that can drastically reduce the computer footprint.

The most recent designs for SFF cases go as low as 3.7 liters (Velka 3 [4]), while still holding a system capable of performing highly demanding tasks, such as 4K video editing. One could buy three of such systems, which cost roughly the same as a desktop, and still be able to fit all of them inside a normal shoe box. Of course, there are some challenges when building a computer in such small cases, with the main ones being listed hereafter.

3 Challenges

3.1 Component size

One of the first consequences of aiming for SFF computers is that not all the components available for desktop computers are going to be fit inside the SFF case. It is common, for example, to find CPU coolers that are as large as the entire SFF computer. This is one of the reasons that planning the build is an import first step when building a SFF computer. Thinking about this specific market, companies started developing solutions to accommodate these costumers, creating components that are smaller in size, but are still able to deliver the same performance as their bigger counterparts.

We can list the most known manufactures for SFF solutions based on each component:

- Motherboards: Usually all components that work with normal size motherboards have their counterparts in mini-ITX[1] size. The most famous ones are from Asus, MSI and Gigabity [5, 6, 7].

- Power Supply Unit (PSU): There a few companies that provide SFX[2], being the famous ones from Corsair, that has options from 450W all the way up to 750W [8].

- Coolers: For small form factor air coolers, Noctua is definitely the best opinion, with their coolers being praised for being quiet and being highly efficient [9]. For the water coolers, Corsair appears again as an excellent option, with many different solutions. Also, Asetek release a new line of water coolers that are very cost efficient [10].

- Graphics Card (GPU): Overall, even for normal size cards, there is not many good alternatives, with Nvidia producing the vast majorities of the GPUs in the market. They also have SFF alternatives, produced by partner companies, such as EVGA and Zotac [11, 12].

Additionally, even though it is a more limited market, the cost for these parts is not too different, since the limited size will result in less material needed to produce them.

3.2 Cooling

The itx components usually have the same level of performance as the normal ones. What this means is that these components produce the some amount of heat, but with a much smaller area to dissipate this heat. Furthermore, because there is no room for the hot air to move around the case, it can create pockets of hot air stuck inside computer. This results in SFF computers being known to operate under higher temperatures than regular desktop computers, reducing the lifespan of the components. The performance of the components can also suffer, since most components have a safety temperature limit called throttling limit, that when is reached cause the components to automatically reduce performance in order to produce less heat.

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[1]The mini-ITX is the motherboard industry terminology for the small size boards used in the SFF computers. We can divide the sizes, from normal to small as normal ATX, micro-ATX, Mini-ITX, Nano-ITX and Pico-ITX. Notice that boards smaller than Mini-ITX will likely lack some features, such as graphics card PCI slots. [**?**]

[2]Terminology for small form factor power supplies.

Of course, these are all worse case scenarios that would only occur with extremely poorly designed cases or when using high power consuming parts without proper care. There are alternatives when aiming for a high performance system though. Among the SFF components that exist, there is also water cooler solutions. As the cost and the troubles associate with water cooling decrease, it is becoming a must for anyone who wants to have the most powerful chips inside SFF cases. It is possible to have one of the most power consuming CPU coolers, such as the AMD R9 3950X that has 16 cores [13], and still maintain temperatures way bellow the throttling limit.

It is worth mentioning that, as water cooling solutions become more common, it is now possible to travel even inside airplanes with the computers. This, of course, varies with the airport, but a simple phone call to check is enough.

3.3 Cable management

An unexpected effect of working in a small case is the cable organization. Because every space inside the case is designed to fit only one component, it is not rare to find it very hard later on to accommodate all the cables that need to come along with these components. The are situations, for example in the design of the Velka 3 case, that if the parts are not assembled in a specific order, it will not be possible to close the case due to the cables. As this is a fairly known problem, the community dedicated for SFF computers came up with a solution. It is now possible to buy custom designed cables that are long enough to reach the components. This solutions saves a lot of space and problem.

Another solution, this time specific for the storage, does not require any cables. The newly designed M.2 drivers can have the same capacity and cost as normal SSD drivers and are connect direct into the motherboards, completely eliminating the need for cables and saving additional space.

3.4 Monitor

One of the first critics when people first hear about small form factor computers is that, differently from laptops, it is not possible to transport a monitor easily. This was true when monitors used to look like big square cubes and weighted a few kilos, but that is not the case anymore. It is a constant pursue of tech companies to achieve thinner screen in other to lighter and thinner components and this technological breakthroughs are used in different areas as well.

Not long ago, taking advantage of the screens developed for cellphones and tablet, a new line of monitor was developed, the portable monitors [14]. As the name suggests, they are thin and light monitors, that are small enough to fit inside a backpack. They have the size of a laptop and do no rely on any external source of power other than the connection with the computer.

These portable monitors are still gaining the market and can cost almost three times the price of a normal monitor. One solution around this is that, if one already possesses a tablet, it is possible to use it as the main monitor of the computer, only needing a small adaptor.

4   When to go SFF?

A SFF computer will not substitute the laptop in terms of practically, when you constantly need store and pick it up everything from your backpack, but the disadvantages or there.

SFF computers are portable, space efficient and are fun to work with. They appear as a solution for a society that needs robust systems, but at the same time cannot afford to waste space and sometimes needs to be ready to pack everything and move to the next challenge.

References

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