Overview

The Printer-to-Computer-Deja-Vu (PTCDV) machine takes the original Printer-to-Computer mod (figure 1) to the next level. It does this by incorporating two complete computer systems in the single printer shell. This will serve as a gaming platform that supports two highly competitive gamers with 21" Sony G520 CRT displays. Figure 2 shows the final assembly of the PTCDV machine, installed on a set of glass top workstation desks. The project was started in July 2004, and final assembly was completed just in time for holiday gaming, on December 27th, 2004.
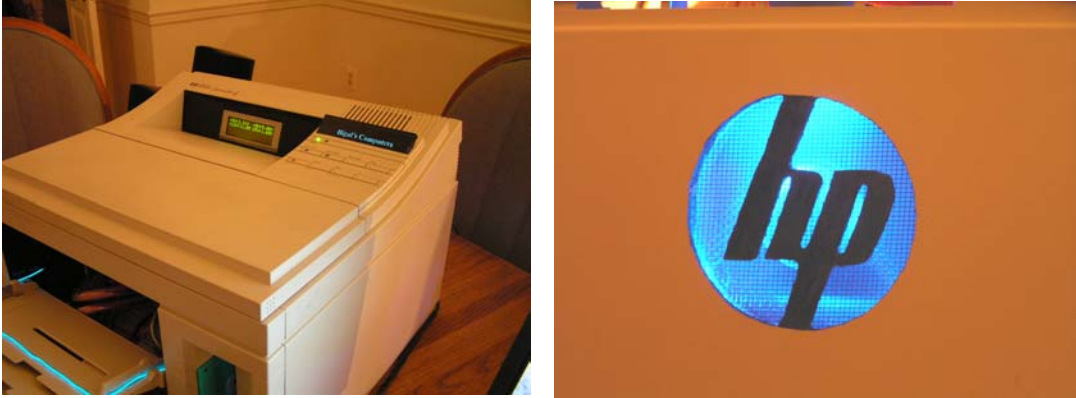

Figure 1 The original printer-to-computer, February 2004

Early design concepts ranged from the reuse of existing components (full size ATX motherboards) to some shortcuts that would get this finished in a month. However, in the end the decision was made to use new micro-ATX motherboards with AMD Athlon XP 2500+ CPUs, high-end videocards (Geforce 6800 GT and Radeon 9800 Pro), one GB of quality memory (Corsair XMS PC3200 DDR) for each system, and a careful design that would allow for further expansion and optimal cooling. This project took several hundred hours of effort, but it was well worth it.
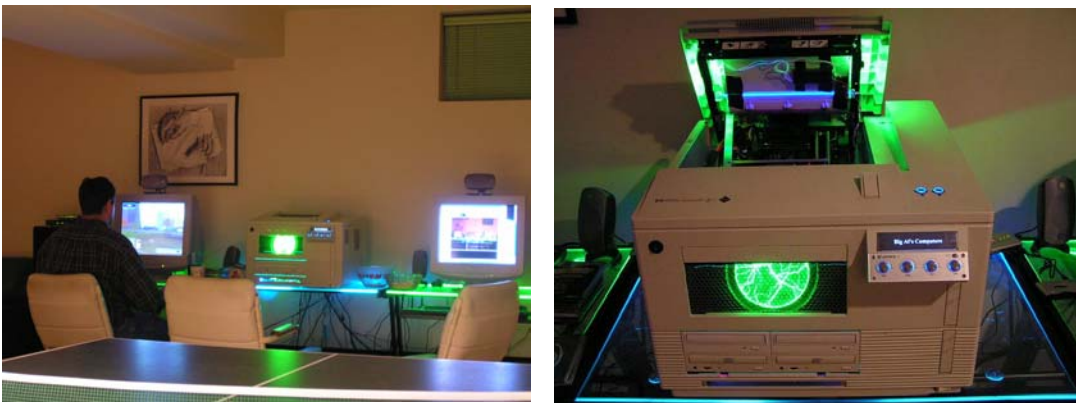

Figure 2 The printer-to-computer-deja-vu machine, December 2004

Early Design Issues

There were some significant design issues to iron out, and these were mostly related to stuffing all those parts into the case without causing a meltdown due to insufficient cooling. The goal was to incorporate the latest state-of-the-art cooling that money can…er…I could afford – a Cooler Master Cross-Flow fan from the Cooler Master Stacker case, and low-RPM fans from Panaflow and Zalman for the CPUs and chassis cooling. The most important cooling item turned out to be the CPU coolers – the Thermalright SI-97. These CPU coolers are lightweight (aluminum) and contain heat pipes. They keep the CPU temperatures low even with low RPM CPU fans.

Issue 1: Where to mount two motherboards in the printer cavity?

> Idea – Mount them on top of each other, with a few inches between the CPU cooler of the bottom motherboard and the top motherboard.
> Idea – Mount one in the cavity, and the other one in the top assembly.

Solution: Initially, I did not decide which motherboard types would be available or what would be purchased, but I elected to mount one motherboard (A) in the bottom cavity, and mount the second motherboard (B) to the top section, underneath the paper output tray. See figures 3 and 4 for reference. Realistically, motherboard B needed to be a micro-ATX size, but motherboard A could have been a regular ATX form factor size.

As it turns out, I opted to buy two micro-ATX motherboards (Chaintech 7NIL-1), so there would be similarity in the two systems. I also bought two Athlon XP 2500+ CPUs, 1 GB of Corsair XMS PC3200 memory (2 X 512 MB) for each motherboard, a PNY Geforce 6800 GT for the top section (B) motherboard, and I got a great deal on an ATI 9800 Pro AGP videocard ($149) for the cavity motherboard (A).
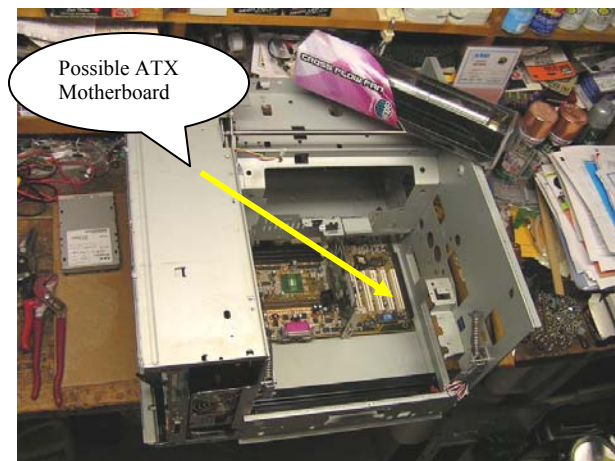

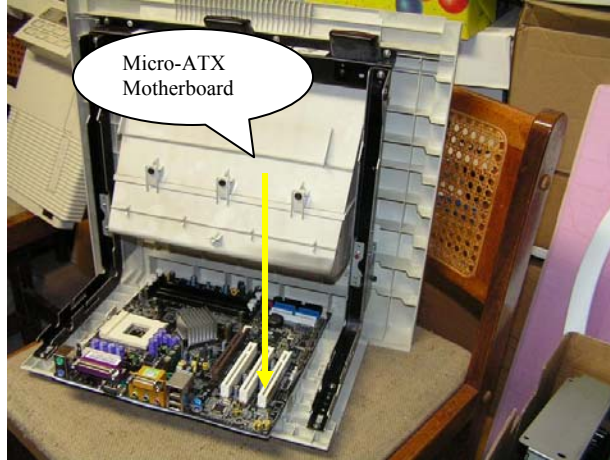**Figure 3 Open cavity showing placement of example ATX motherboard**

Figure 4 Top section (rear portion) supports micro-ATX motherboard

Issue 2: Where to mount four optical drives in the printer cavity?

Idea – front paper tray holes, either the top window or bottom window

Solution: It made sense to mount drives in bottom window, so I could leave the top window open for visual display. I had all sorts of grand ideas for the visual display, including holograms, LED / glass prisms, spinning LED globes, etc. The final choice is discussed later. Figures 5, 6, and 7 show how I needed to enlarge the lower window to fit the optical drives side-by-side. In figure 8, you can see the bottom support bracket I salvaged from the parts bin to hold the drives in place. Getting access to this support bracket once the machine is assembled can be very difficult, but it is possible.
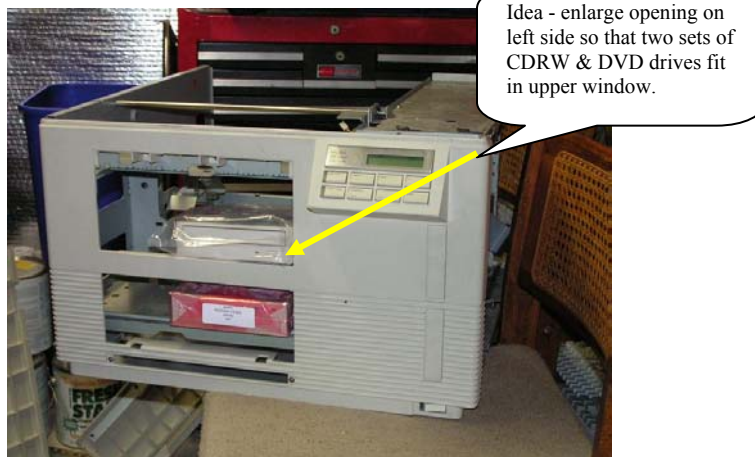

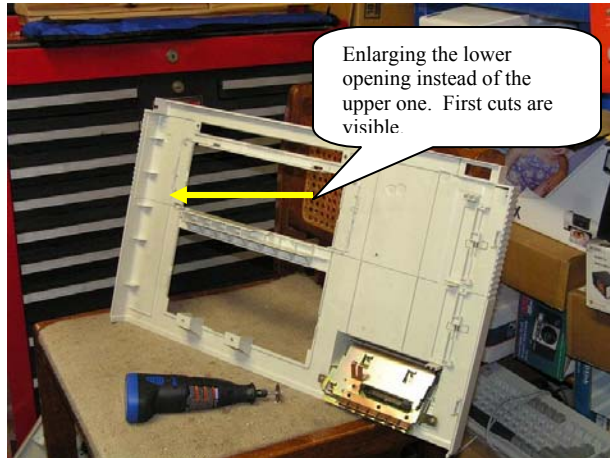**Figure 5 Where to mount two sets of optical drives – in paper tray openings?**

Figure 6 Enlarging the opening at the bottom tray, leaving top intact

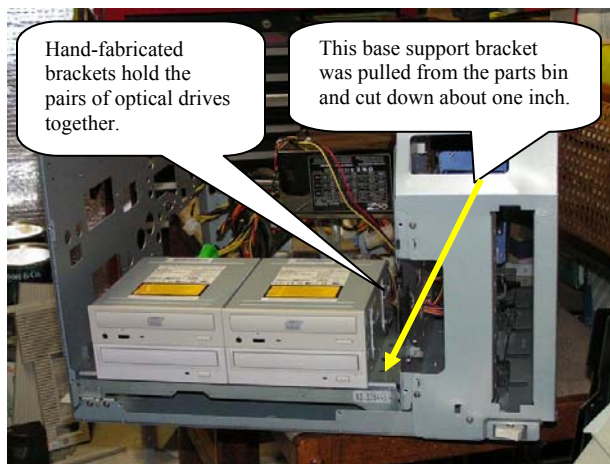**Figure 7 First test fit for side-by-side optical drives – need ¼" more room**

Figure 8 Fabricating a support bracket for the optical drives

Issue 3: Should I test the parts as they come in?

Idea – Yes, drop whatever I'm doing and test the parts the minute they arrive
Idea – Wait until I have a place to install the part, and hope for the best

Solution: If it's possible, you should test the components right away, in case they are defective and you need to do a warranty return. There was a small chip in the die of one of the Athlon XP 2500+ CPUs, but it ran fine when tested. I even installed Windows XP while I was at it.
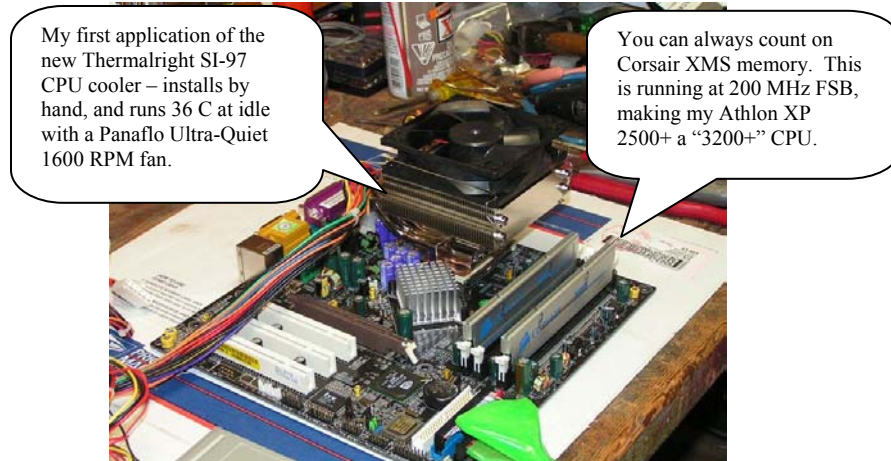

My first application of the new Thermalright SI-97 CPU cooler – installs by hand, and runs 36 C at idle with a Panaflo Ultra-Quiet 1600 RPM fan.

You can always count on Corsair XMS memory. This is running at 200 MHz FSB, making my Athlon XP 2500+ a "3200+" CPU.

Figure 9 Bench testing one of the Chaintech Micro-ATX motherboards

Issue 4: Where to mount two power supplies in the printer cavity?

Idea – same as original printer design (mount in side cavity), but use only a front to rear fan-type power supply.
Idea – mount primary power supply (520 Watt OCZ) in the central cavity, exhausting into the side cavity used by the secondary power supply.

Solution: The primary power supply is mounted inside the cavity, but it exhausts to the side cavity that houses the secondary power supply. See figure 10, and you will note that this will draw air from within the cavity and exhaust it to the side cavity (Where I better draw it out!). The secondary power supply therefore mounts in the expected location, approximately where HP had their power supply board(s). See figure 11 for that one. Note the exhaust fan (stock location for the printer, but a quality fan for this application), which should draw hot air away from the top section motherboard (B). As it turned out, the top section motherboard runs extremely cool – maybe 6 to 8 degrees centigrade cooler than the cavity motherboard.
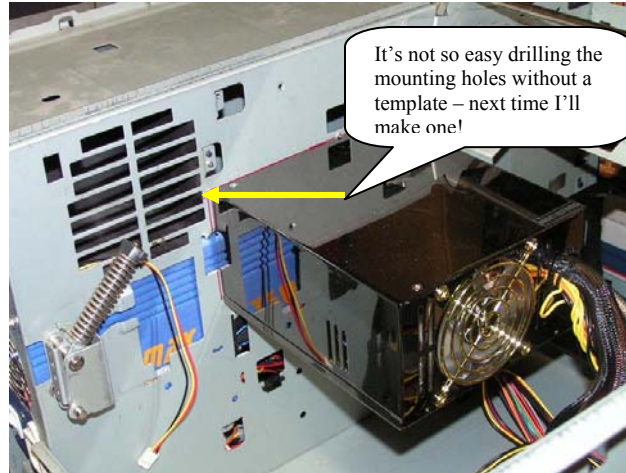
Figure 10 Power supply for primary motherboard

Figure 11 Raidmax "500 W" power supply for secondary motherboard

Issue 5: Where to mount two sets of hard drives?

Idea – For good air flow, mount one pair in the side cavity near the secondary power supply (with fan support as necessary).
Idea – Mount a pair under the support bracket in front, and use a second cross-flow fan for airflow across the drives.
Idea – Mount a pair in the rear, under the top assembly and behind the cavity motherboard.

Solution: I elected to mount the two drives for the primary (top section) motherboard B at the rear of the internal cavity. I mounted the pair of drives for the secondary (cavity section) motherboard A in a 3.5" cage attached to the side power supply cavity. See figures 12 and 13.

> I made these support brackets by cutting up a piece of metal salvaged from the printer.
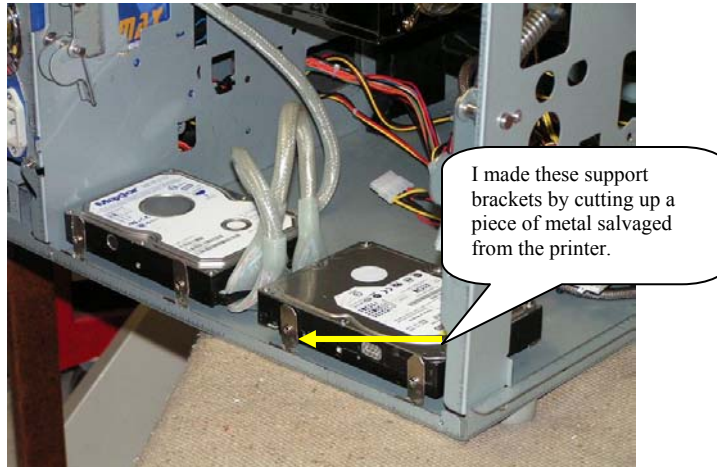
Figure 12 Pair of hard drives for primary (top section) motherboard B

> This is a drive cage salvaged from an old computer that was being scrapped. I thank my friend James for saving it from the dumpster.
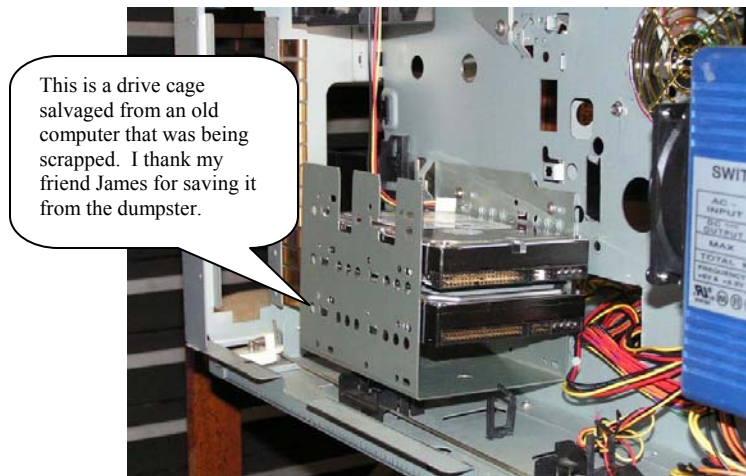
Figure 13 Pair of hard drives for the secondary (cavity) motherboard A

Issue 6: Where to mount two floppy drives in the printer cavity?

Idea – Mount in rear, and use font cartridge holes for fan openings (to hard drives)
Idea – Provide the cables and power connectors an external outlet, but leave out the floppy drives. They could be attached when needed prior to system(s) boot.

This was a tough decision. Floppy drives are used very often – mostly just during the install process and perhaps for bios updates. However, I did locate a good place to place these permanently, and they are out of the way. As shown in figures 14 and 15, they are mounted in the rear, next to the side cavity power supply. The cables from both motherboards reached this location, using standard 18" floppy cables.

Figure 14 Pair of floppy drives mounted in rear, to internal side panel

This is the main exit port for all wiring going to the internal motherboards – audio, video, USB, etc.
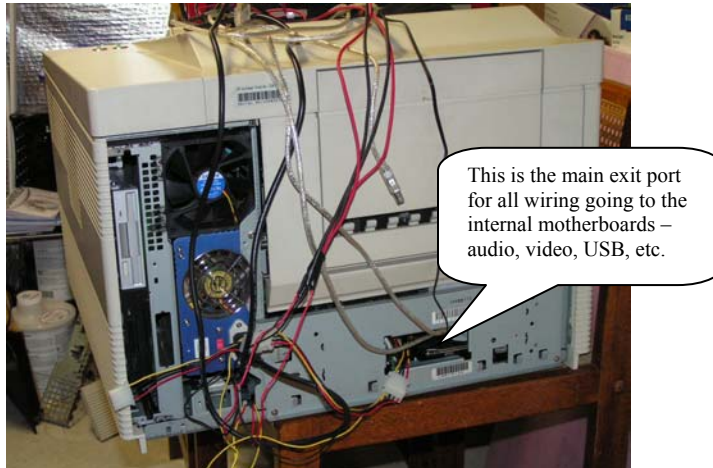
Figure 15 Pair of floppy drives next to power supply, shown in rear view

Issue 7: Where to mount the case badge (logo) and fan controller?

> Idea – Mount them in the top cover
> Idea – Incorporate them into LCD / switch panel assembly

Since I wanted to mount a "Big Al's Computers" electroluminescent case badge (or logo) where the HP single-line LCD display was, I chose to mount a Cooler Master AeroGate I fan controller in the same area. This meant an entire replacement of the stock LCD / switch panel assembly. Figures 16 through 21 provide insight as to what was removed, and how I inserted the new items.

Figure 16 "Big Al's Computers" logo, a stencil illuminated with an EL panel

The Dremel tool makes cutting plastic a breeze. I highly recommend one.

Figure 17 Cutting out the stock LCD / switch panel assembly panel

The AeroGate I sides wouldn't just slide in, due to the < 90 degree angle on the bottom.
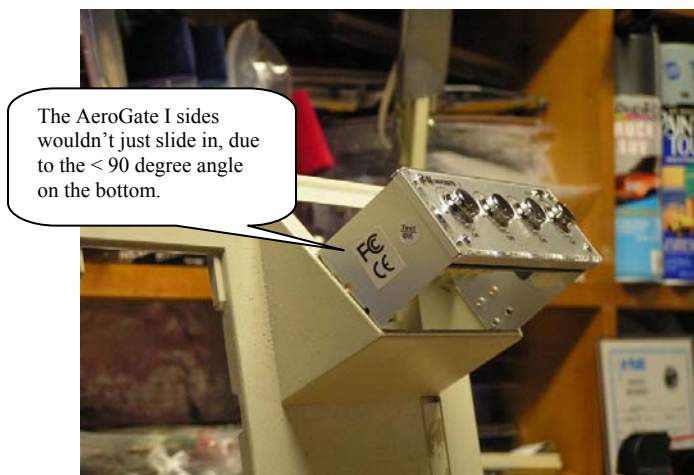
Figure 18 First alignment check for the Cooler Master AeroGate I Fan Controller
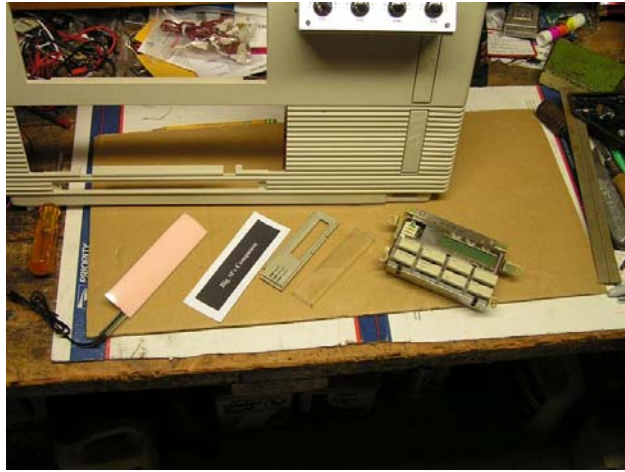
Figure 19 The old HP LCD / switch panel assembly and the new EL logo components

I had to be very careful here – too much grinding and I would poke through the bottom!
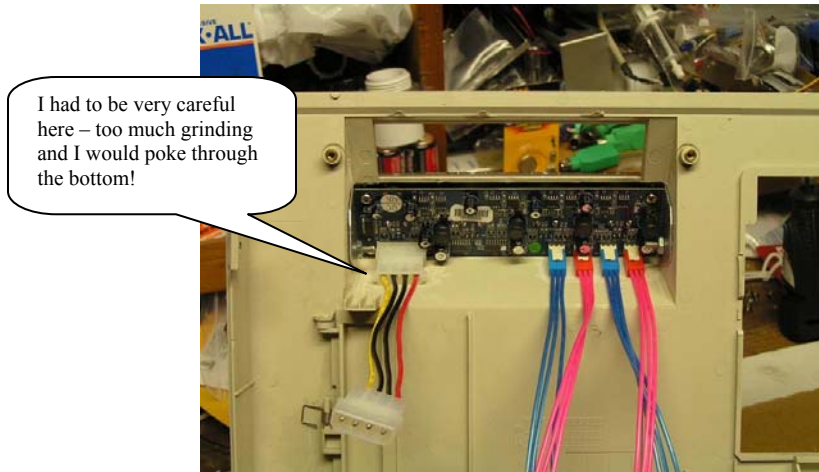
Figure 20 I had to gouge out plastic for the connectors on the back of the fan controller!

Cooler Master makes the best stuff! By pressing this switch, the color scheme changes between blue, green, and red.

Figure 21 Close-up of the completed logo / AeroGate I panel

Late Design Issues

Issue 8: Where to mount power switches and the hard drive LEDs?

       Idea – Mount to a custom panel that replaces the current HP switch panel
       Idea – Mount underneath the current HP switch panel
       Idea – Mount to top cover

With such a special system in development here (yes, my personal opinion), I just had to use some unique switches. Unique switches are expensive though, so I was only going to buy two – one for each system. These would be my power switches, and the reset switches ended up being hidden in the cavity, beneath the top cover. The power switches would be on display, but where? It took me several days to decide upon the final location, in the top cover, near the logo / AeroGate I panel. This was to be an easy location for mounting switches and hard drive LEDs, since I could take the top cover off in about five minutes. But nothing is easy in case modding. I had to cut out the metal cover plate below the switches, and soon after I had them installed, a nice static electricity charge blew out one of the LEDs of a switch when I touched it. Duh. I mounted the switches in plastic, with no metal to serve as a ground path for ESD events. I therefore pulled the assembly out and wired in some grounding wire, along with replacing the switch that had the blown LED. At $15 a pop, I wasn't going to blow another LED. Figures 22-25 show you the power switch installation.
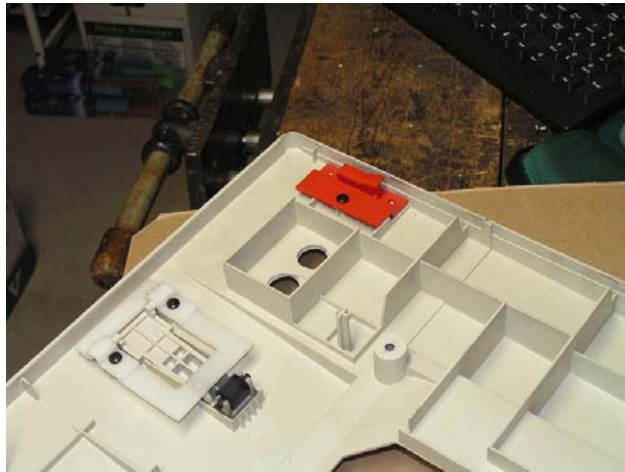

Figure 22 Drilling the power switch holes was no problem…..
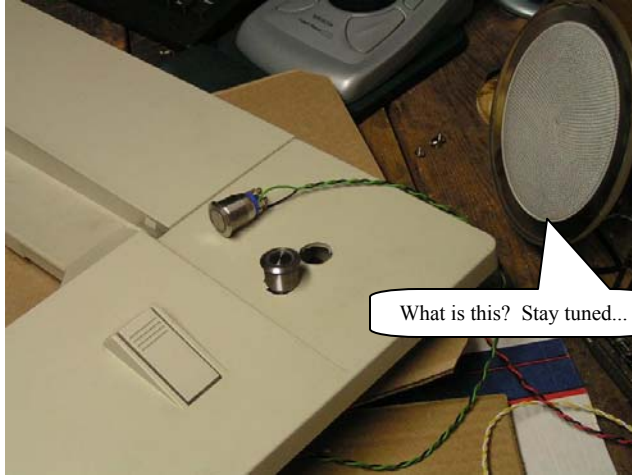
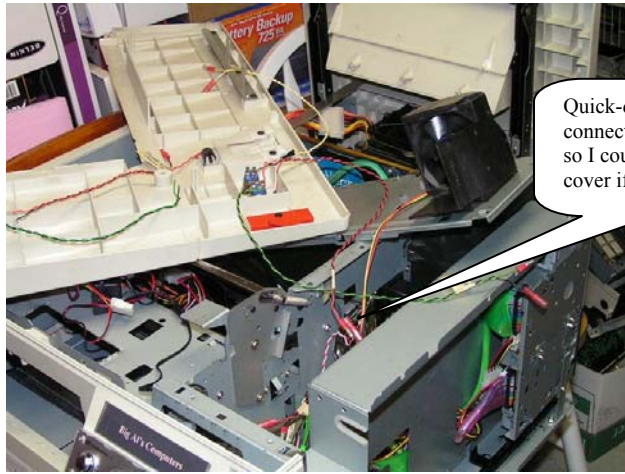**Figure 23 And fitting the switches in the holes was no problem…..**

Figure 24 But there were a few wires to add removable connectors to!

Figure 25 Final install of the power switches and hard drive LEDs

Issue 9: Where to mount decorative lights to finish this machine in style?

Idea – Create a "system status" display for each motherboard in the front cover
Idea – Forgo LEDs and use EL wire and cold cathodes
Idea – Add some cold cathodes to the tables supporting the machine.

I like lighting effects. Cold cathodes, EL wire, and stuff like that just brings tears to my eyes. I wanted UV cold cathodes inside the printer cavity to light up the UV-sensitive cables, and I wanted EL wire acting to highlight sections where possible. So, I decided that a "system status" display, such as dual 4-line LCDs (one for each motherboard) was not going to be part of this project. Instead, I concentrated on an eye-catching display in the central cavity, which I also lined with 3" wide black duct tape. This device is the Lumin Disk from Spencer Gifts. It is a high voltage electrode in a glass plate, but on a small scale of only 6" in diameter. I had to do some cutting to make it fit above the optical drives, but the end result really sets the machine apart. Figures 26-30 reveal how I integrated the lighting effects.
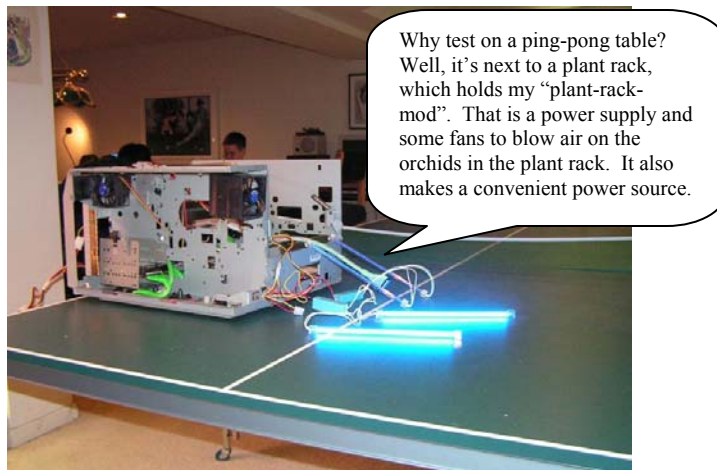

Why test on a ping-pong table? Well, it's next to a plant rack, which holds my "plant-rack-mod". That is a power supply and some fans to blow air on the orchids in the plant rack. It also makes a convenient power source.

Figure 26 Testing the switch control for a pair of cold cathode lights

How cool is that? But what about data corruption from high voltage?

Figure 27 The Lumin Disk and a UV-sensitive 80mm fan

I was prepared to line the cavity with aluminum foil or metal tape. No interference problems were found though, so I just lined the cavity with black duct tape.
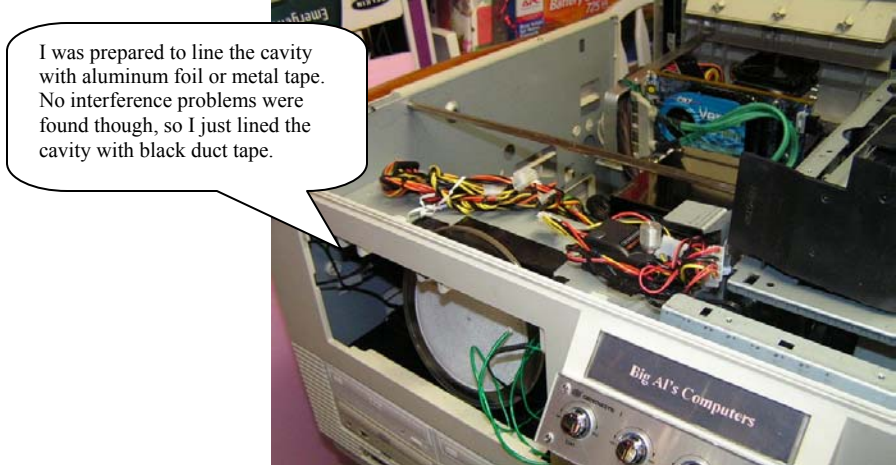
Figure 28 Cutting the interior top to provide room for the Lumin Disk
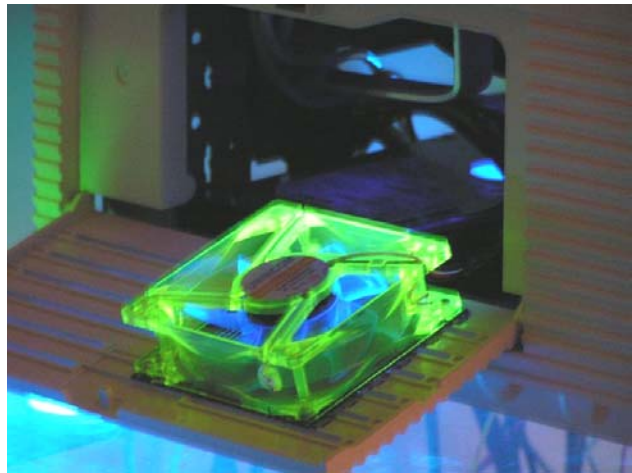
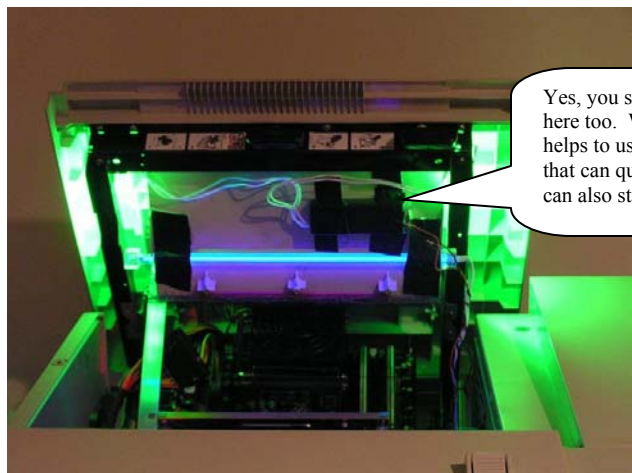**Figure 29 The UV-sensitive 80mm fan installed in the side panel**

Yes, you see some black duct tape here too. When placing lights, It helps to use a mounting material that can quickly be ripped out. It can also stay put, as we see here!

Figure 30 The top section opened to reveal green and UV type cold cathodes

Is it done yet?

This was a very successful project. In terms of gaming, both systems are top performers.
The secondary system, with its motherboard buried in the printer cavity, does run about
six degrees hotter, but seldom reaches 50 C during extensive load. I am considering the
addition of another internal case fan, but to install this, I may have to disassemble about
half the machine. All case modders know that we can't leave these projects alone. There
is always something else to try, a new toy to install, and things of this nature. See the last
section for pictures of the major components that went into this project.

In terms of power concerns, the single UPS is easily able to handle the load of two
systems; good thing I bought the APC 1500 unit! I was concerned that there would be an
excessive power draw from the primary system, but I took care of that by using a 520
watt power supply from OCZ. Overall, the normal loading is just over 600 watts and the
runtime on the backup battery is about 6 minutes, according to the APC monitoring
application. I haven't checked my electricity bill yet!

In figure 31, we have a final picture with my current build plate. This might help you
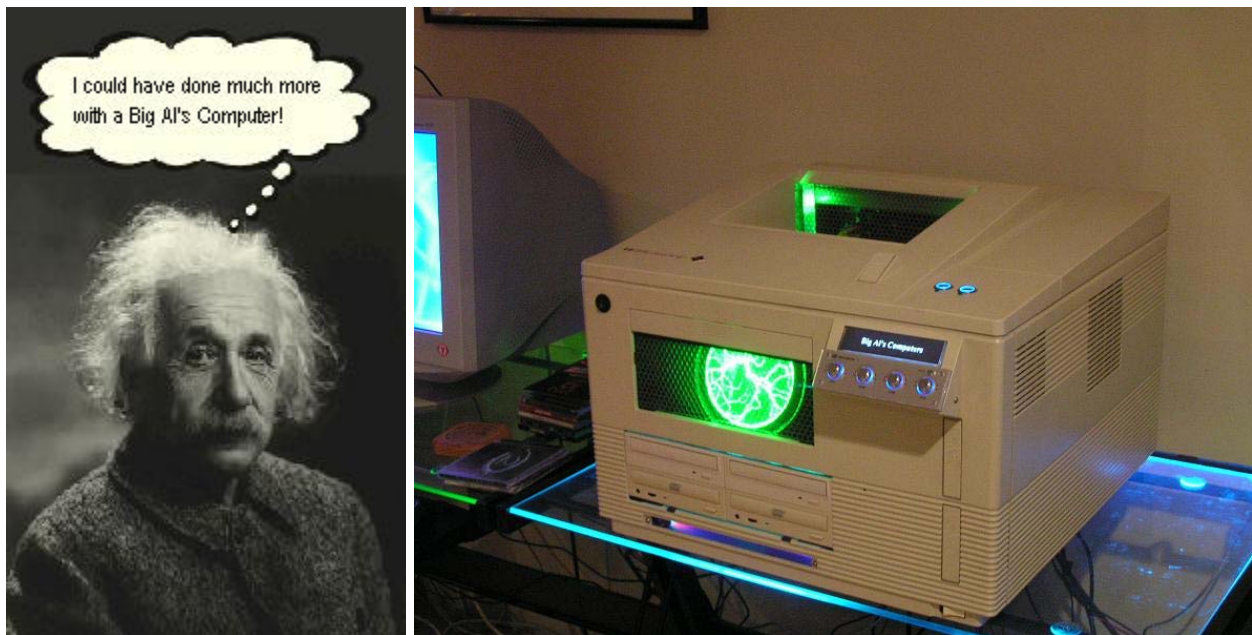understand why case modding is worth the price of admission – lots of time and money!

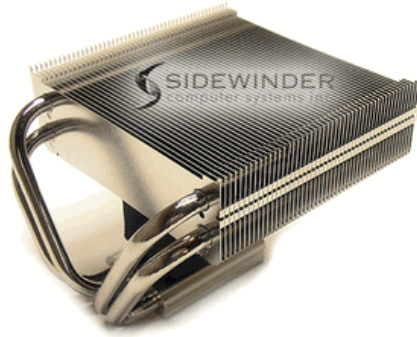**Figure 31 Build plate and final system picture**
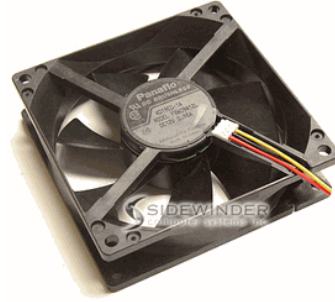
Major Components Procured (prices paid withheld to protect my marriage)

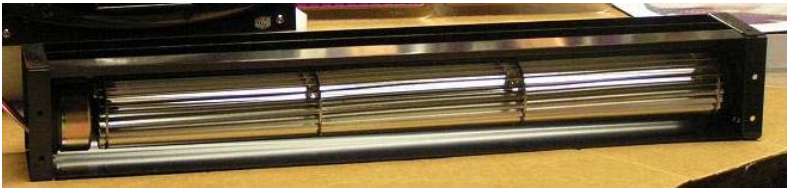Thermalright SI-97 (x2)

Panaflo 92x25mm Ultra Quiet (x2)

Optical drives from computer show,
DVD (x2) and CD/RW (x2)

Chaintech 7NIL1-Summit Nforce2 Ultra
400 micro-ATX motherboard (x2)

Cooler Master Cross-flow fan

WD IDE hard drives (x4)

Corsair XMS 1GB DDR PC3200 (two
sticks of 512 MB) for each 7NIL1)

Cold cathode kits, multiple colors (x6)

Major Components Procured, continued
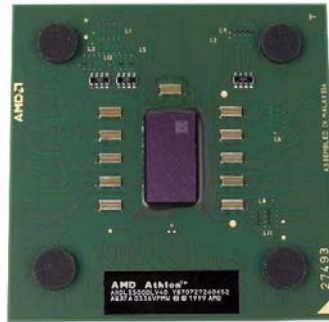

PNY GeForce 6800 GT videocard

ATI 9800 Pro videocard

Electroluminescent (EL) wire kits (x2)

The all-powerful AMD Athlon XP 2500+ (x2)

Cooler Master Aero Gate I Fan Controller

Lumin Disk (6" diameter) from Spencer Gifts

*I could have done so much more
....with a Big Al's Computer!*