

Picture Frame Project

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Intro

Tammy wanted to have a large, yet affordable LCD picture frame, displaying digital images on the wall. She couldn't find ones in the 8 x 10 range, and the largest she could find were in the \$800 range.

She investigated on the internet, and found tips on how to disassemble a laptop computer, and reassemble it inside a picture frame.

- <http://www.grynx.com/projects/laptop-on-the-wall-walltop>
- <http://www.ferhoodle.com>

We decided to try it out, and see if we can do a few 8 x 10 frames like this around the house. We wanted to pull images from a server on our home network, and send them to various picture frames using wireless network cards.

We were hoping, as a bonus, to have a good operating system, and software, so we could also display movies, or webcams from around the world (or solar system!), or a weather or financial website, for example. Even a nice, fractal screensaver (or those swimming fish) would be cool.

Imagine having a large picture frame on the wall showing live, real-time images of Paris and London. Or, the kids in portraits, like in Harry Potter, moving and waving or walking away for awhile. All this is possible with one of these frames! To start, we'll even be happy with a simple slideshow of baby pictures.

The Computers

We went to a local mom-and-pop computer shop. They had tons of old, beat up laptops they were working on. They sold us two old laptops:

- Dell Latitude CSX

- Pentium III
- 650 MHz / 700 Mhz
- No batteries
- No peripherals (no floppies or anything)
- Broken power cords
 - One had a broken clip but worked
 - One had a broken wire inside, and didn't work at all
- 6 Gig/10 Gig hard drive
- 64 MB RAM/128 MB RAM
- \$70 each

The screens are nice and large! They each had an 8.5" x 11.25" screen.

We worried about the small RAM. The other laptop had larger RAM, and the screen was the same size, but was probably not an active matrix display. Or at least, the picture quality would reduce dramatically if you looked at it from below the center and from the left or right side. This wasn't a problem if you looked down on the screen from above center. It was fine as you moved your head from left to right. But the minute your eyes crossed below the center line, things were different! We figured we could turn this screen upside down to use it.

The computer shop lent us a CD ROM drive, so we could load up an operating system. We have to return it next week. We'll probably wind up keeping it and paying \$10 for it.

They may have a batch of more computers they were planning to put on eBay. They later called and said they had a ton more come in. We're planning to go buy more.

The Software

We will probably migrate to Linux soon, for small footprint and licensing. For the first one, here's what we did:

- Loaded Windows XP Pro, SP2
 - We had licensed copies to use, but we're running out, so Linux is next.
- Named the computer "Frame1"
- Wrote the Admin password somewhere safe for the future
- Loaded drivers for a Linksys WPC-11 802.11 Wireless Network PC Card
 - We had a few spare wireless cards lying around (yes, we did)
- Installed the Network PC card
- Set WEP encryption key and Workstation network name to match home network
- Got online and updated Windows
 - Installed Internet Explorer 7, though that may not have been smart
 - Took over an hour!
- Loaded up IrfanView slideshow software (v 3.99)
 - A really great and free product!
 - Also installed all the plug-ins for it (from a single exe file on the site)
- Loaded Quicktime, to display any movies

- Turned off automatic updates
- Installed UltraVNC server (v 1.0.2). It's free!
 - Simple password, and no MS authentication
 - Allow loopback (probably not necessary to do)
 - Unchecked "Remove wallpaper" option
 - It's OK to view wallpaper on fast home network
 - Wrote VNC password somewhere safe for the future
- Told Windows Firewall not to worry about lack of virus software
- Configured Windows Firewall to let home network machines access UltraVNC Server
 - In the firewall settings, add program (could also add port, but we didn't)
- Installed Java Runtime SE v 1.4.2_11 (v. 13 on Frame2)
 - Disabled the automatic updates and icon in system tray
 - Strictly not needed at first, but we thought Java may come in handy one day on the computer
- Created a batch file in WordPad and put it in the folder: Documents and Settings\All Users\Startup\Programs\Start
 - This bat file opens another bat file on the server computer, which will tell the frame what to do on startup.
 - "[\\Server1\Frames\LaunchFrame1.bat](#)"
 - That's it. That's the whole contents of the bat file!
 - Frame2, of course, gets "LaunchFrame2.bat"
 - Server1 has a shared folder on the home network called Frames
- Shared that folder on Server1, called Frames, with a sub folder for Frame 1.
 - We tested the system first with a simple shared folder in Shared Documents. It worked fine.
- Created another shared folder, also called "Frames" on another server (Server2)
 - It didn't have to have the same name. We just did it that way.
- Put pictures in the Frame1 folder within Server2's Frames folder
 - Later, created folders for each frame to use: Frame1, Frame2, etc
 - With the Irfan slideshow software, you can also drop Quicktime movies or animated GIFs into the folder, and they will be shown, too!
- Created *LaunchFrame1.bat* and put it in Frames directory of Server1.
 - This file just says: "C:\Program Files\IrfanView\i_view32.exe" /slideshow="\\Server2\Frames\Frame1"
 - It tells Frame1 to launch the slideshow on startup, and point it to the folder on another server where the pictures are.
 - We use this double-redirection, simply because the other server computer (Server2) hardly gets rebooted, compared to Server1. Server2 has a bigger hard drive that can be accessed continually without bothering anyone, and is where the media should be located.
 - We can also change the bat file on Server1, and make the frame do other things, without poking around with the frame itself.
 - Copied this file and changed the "1" to a "2" in all places that said "Frame" for Frame2

- We also installed the UltraVNC (viewer only) software on other computers, to reach and alter the frame as needed.
 - The only possible issue is that we need to know the IP address assigned to the frames to reach the correct one. We're letting them be assigned dynamically by the home network. We think it won't be too hard to figure out the IP address once it's all online OK. So far, Frame1 has always been 195.168.1.5 and Frame2 is 195.168.1.6. Ultra VNC connects at port 5900 via the viewer software.
 - So, to connect to Frame1, for example, we would open the VNC viewer on another computer, type "195.168.1.5:5900" and hit *Connect*. We are then prompted for the password we gave VNC when we installed it in the frame. Once it connects, we see the desktop of the frame computer and can type in it and use the mouse, etc.
 - Without a keyboard on the frame, this is how we do things with the frame's operating system.
- Purchased and installed Portrait's PivotPro, to turn Frame Two's window upside down
 - This allows better viewing angle of the images. The screen was designed to look better when you looked down on it, apparently
 - Some graphics drivers allow you to do this by holding down CTL-arrow down, CTL-arrow up, etc. Neither of ours did, so we had to go with Pivot Pro, which worked like a charm!
 - Incidentally, the screen does not look upside down when viewing it from another computer using UltraVNC. That's very good.

Disassembly

We just basically took all the screws out and removed the motherboard from the sheathing. Some of the screws for the panel display were covered in stickers. We just peeled the stickers, then unscrewed the laptop. We CAREFULLY removed the cable wire to separate the LCD panel from the motherboard, and not-so-carefully yanked out the keyboard cable from the motherboard.

The kick-prevention screws at the back, by each socket, had to be removed, along with a couple of screws on the fan's heat-sink, in order to get the metal backing off the motherboard.

We traced the wiring to the speakers, which shared a cable connect with the touchpad and bios batteries, just in case we want to re-connect the speakers directly to the motherboard. On these models, they were pins 2 & 3, and 4 & 5 of the motherboard socket (looking from the top left, with the curved corners at the top).

The two laptops were Dell Latitude CSX's, but different years or styles. One was much harder than the other to disassemble. It had loctite or something holding many screws

and parts together. But a little elbow grease and care, and everything came apart in under half an hour (more like 10 minutes).

Without the keyboard it booted up! Just a motherboard and LCD panel lying on the table, and it worked. It was pretty cool!



We were worried all the time about the delicate LCD panel. But, we accidentally dropped one at least four feet onto the kitchen floor! It still worked fine!

NOTE on Bios:

At one point, one of the computers wouldn't boot up without the keyboard, saying a change needed to be made in the BIOS, and to push F2. We had to reconnect the keyboard and hit F2, then made no changes. We just hit escape, and rebooted. After that, we didn't need the keyboard anymore. I'm thinking maybe the removal of the bios batteries reset any bios changes made, and it just needed to know that we saw that the bios had been changed, or a flag had been raised that the date and time needed to be set. But apparently, once you look in the bios, it clears that flag, and things are happy again.

So we believe that all the changes made to the bios on the laptops, such as "boot first from the CD Rom", are wiped clean. One laptop bios had a "POST" setting to not care so much about hardware checks when booting up (like missing keyboards!). The other laptop didn't have this feature. Either way, neither seemed to mind. A person on the web said they had to rewire the touchpad to stop a bios POST error. We were lucky this didn't happen.

Frame

Tammy bought frames with deep backs (but not shadow boxes) from IKEA (she bought Ribba frames). She cut a hole in foam board, which she bought at Hobby Lobby, and fit the LCD panel in it. Then she glued the LCD panel to the foam board with Liquid Nails. It takes about an hour or two to set. The glue got everywhere, but was relatively easy to clean off the screen. On the second frame, the panel fit so snugly into the foam board, that we didn't need to glue it!



Then she got matting from Hobby Lobby for ~ \$7 each, cut to the dimensions of the LCD Panel on the inside and the frame dimensions on the outside of the mat.

One frame was much larger than the other. For the smaller frame, we intended to cut a notch in the backing board for the LCD cable, and mount the motherboard on the board over the panel. Screw it. We bought a bigger frame.

As mentioned at the beginning of this document, one of the LCD panels is not TFT Active Matrix, or whatever, we believe. When you look at it from the side, the image degrades quickly. From above, the issue is not bad, but from below eye level, it's serious. We think it's designed that way for people looking down at their laptop monitors. We flipped the screen upside down to get the image looking good when viewing it in a picture frame.

If the graphics card allowed, as many do, we could have just hit Ctl-Alt-<Down Arrow> to flip the screen upside down. A worse case scenario would be to simply batch flip all the images upside down before putting them in the Frame2 folder on the server. Then, we just flip the display upside down in the frame and show upside down images. But, that would limit the functionality if we wanted to do other screensavers or webcams, etc. So,

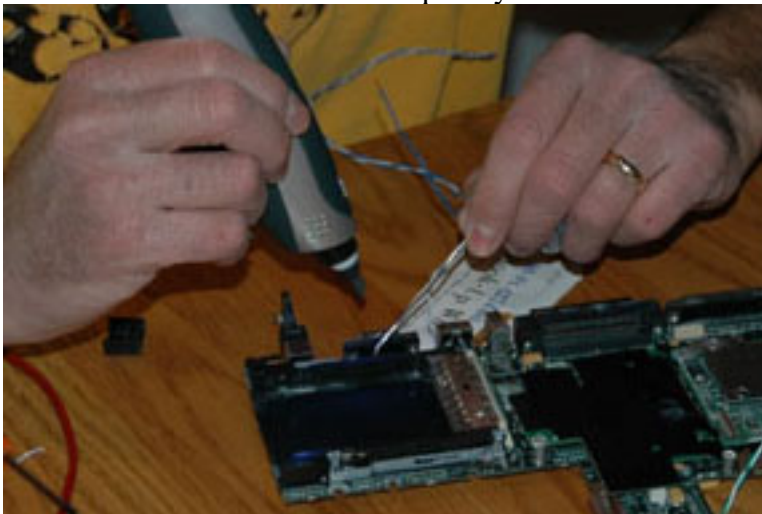
we opted to use Portrait's PivotPro software. It can flip the screen in any orientation. Worked great! It costs money, though. We figure we'll "amortize" it over several frames.

Wiring

We purchased moment push-buttons from Radio Shack (expensive place!!). Found some old CAT-5 cable lying around and cannibalized the thin wires inside, to make a thin power cord (to be non-obtrusive when leaving the picture frame, until it goes to the transformer brick). Bought some RJ-45 male and female connectors and a crimper at Home Depot.

Soldered two CAT-5 wires to the on/off switch. The wires were maybe 6 inches long each. On the Dell laptops we used, there were 5 connections to the on/off switch on the motherboard. But only two wires are needed for a power switch. Hmm. It took a while to figure out which connections did what. We used an ohm-meter we have. We touched the connections and noticed when the resistance fell to nearly zero when the power button was pushed. The power button on the laptop is so tiny, we used a screwdriver to push it down. Hence the reason for all this wiring to hook up a bigger button. It was so tight on the motherboard, that we wrapped a couple of scrap pieces of CAT-5 wire to the ends of the ohm-meter wires. This made narrow enough ends for us to touch the various switch connections to measure the resistance.

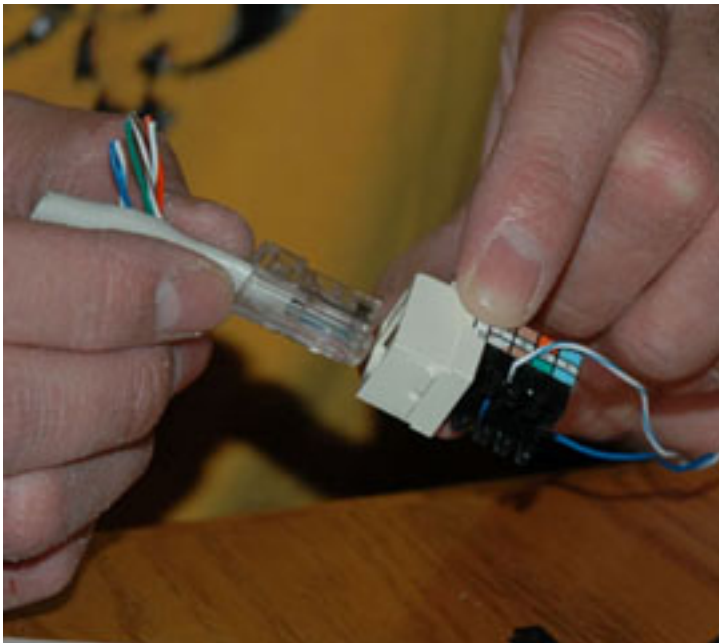
When looking at the switch from above and from the back, where you are facing the back connectors, like the power connector, the top two pins (furthest from the back) on the left side (towards center of motherboard) and the top right one on the other side of the switch seemed to be ground, and the lower pins (closest to the back of the computer) on either side seemed to be the other connection. We soldered wires to the upper left and lower right connections, using a cool (literally!) cold-soldering gun. It didn't work at first, because the solder on the right side (the connection closest to the side of the computer) was also touching the on/off button's top casing, which shorted the connection with the other side. Once that was cleared away (re-soldering it more carefully), the computer would turn on and off when we quickly touched the wires together!



Technically, we could have screwed or soldered the ground wire to any grounded part of the motherboard (much like you don't need to have the negative jumper cable directly on the battery when jumping a car). But we soldered both wires to the switch directly.

Then we hooked these wires to the outer pins of an RJ-45 socket. Just slide the unstripped wires into the desired slots on the RJ-45 socket, and use the punch tool (included in the package of sockets) to push the wires down firmly into the slots. That's it, connection made. It was a little tricky to figure out which slots were the outer connections of the socket. We examined an existing cable to see that a solid wire and the white one with orange stripe were the outer connections, and we followed the diagrams on the socket itself. Those were slots numbered 1 and 8 on our sockets (which makes sense!). It's not strictly necessary to use the outer connections. We just did that to keep the wires as far apart as we could, and also to avoid mistakes and time in the future, trying to figure out which connections to do on the other end. It's also a good idea to stay consistent, so you can interchange these sockets and connections in the future, too.

The other end was even easier. That's the male RJ-45 head connector. We simply took two more pieces of CAT-5 wire, about the same size as on the on/off switch. We slid the wires into the far ends of the connector head, slid the head into the crimper tool we got at Home Depot for something like \$20, and pressed down like a stapler. Crimping it was that easy. Done and done.



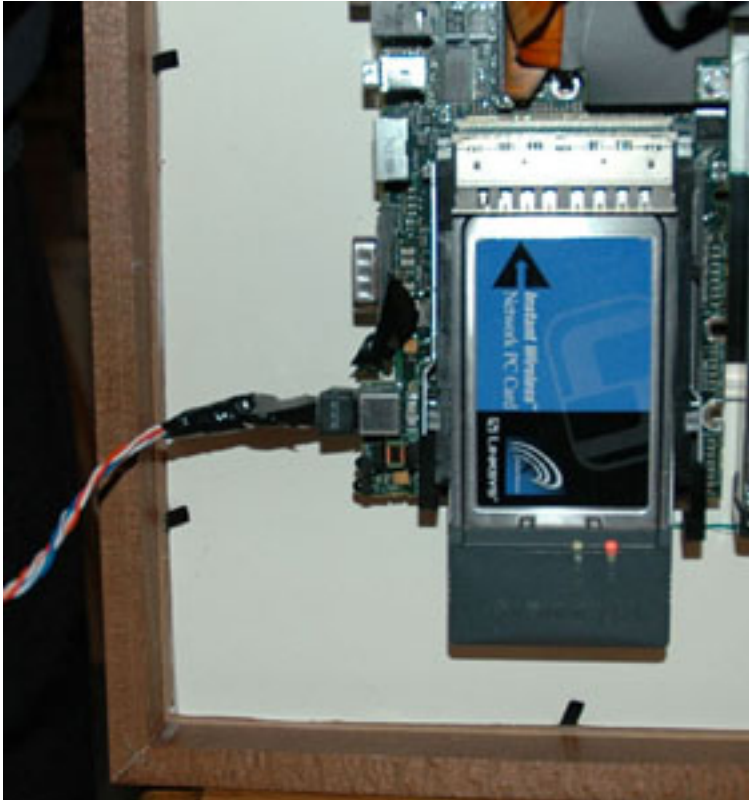
We connected the other ends of the wires coming from the RJ-45 male connector to the push-button switch we bought. Why did we put connectors in the middle, between the computer's tiny switch and our human-usable switch? Because if we wish to separate the motherboard and the frame, we don't have to rip out wires or the switch, which might be embedded or attached to the frame. We can simply disconnect it. We are also planning to

use a different switch down the road which would be more of a soft, touch-type (like maybe from the inside of a keyboard button?). When we're ready to do that, we can simply reconnect the new switch. No need to re-solder.

The power cord made us nervous at first, but once we did it, we felt fine. Reading other people's stories on the net, we decided to use TWO pair of CAT-5 wires for the power cord. This seemed safer with the power draw on such thin-gauge wire. Even four wires coming down from the frame is much smaller than the original power cable. We don't recommend trying this at home to anyone, for safety and liability issues. In fact, we officially don't recommend doing ANY of this. ☺



We cut the power cord just after the connection into the laptop. One of the cables had an insulated wire wrapped by the other wire, not separately insulated inside. The other cable we used had both wires insulated inside. We stripped the ends of the four CAT-5 wires, wrapped two each together, and wrapped each one of these pairs to one of the wires in the power cable. A trick here is to remember which wire was wrapped together on each end, so you don't cross over the connection. Black electrical tape was used to secure things. We probably way over-did the electrical tape, but it's better to be safe than sorry. By the way, we made the CAT-5 wires about 7 feet long. We just thought that would be a good length to have the power transformer brick lying on the floor from any place we hang the frame. And that length didn't seem too long, where we might worry about heating up the tiny wires so much. This is just our reasoning. There was no scientific fact about it.



We didn't yet re-hook the speakers, but we traced the pins, in case we want to do that. We know which pins belong to the speakers on the motherboard socket that would have connected to the touchpad. Ditto with the BIOS batteries (little button batteries wrapped together. They are connected to the same socket on different pins. If we need them, we'll reconnect them to the motherboard and tape them anywhere on the back of the frame. We pulled the microphone off its little stand on the motherboard, so it wouldn't stick up too far, but kept it connected and sitting on the side.

We could probably hook up a remote control (or our Palm Pilots) to use the infrared port on the motherboard somehow. Then we can pause or change pictures on the frame via remote control. We haven't been that motivated yet. Perhaps we'll do that another time.

Booting Up

Everything booted up fine!

Frame 2 powered up and away we went!

Frame 1 lost the ability to use the PCMCIA sockets (PC Card socket) along the way. We may have damaged it during soldering? So, now it won't be able to use our PC wireless cards.

We had to reconnect the keyboard to the motherboard to try to reload drivers, and tried all sorts of things. It was a pain in the neck, as one person had to hold or prop up the LCD

panel carefully while the other used the keyboard. There was no casing to hold or protect any of this. Sometimes, we placed a sheet of paper between the motherboard and keyboard, to prevent metal touching metal. We plugged in the CD player, too, so we could reload drivers, and even Windows itself.

In the end, we determined it was a hardware failure of the PC card socket. It wouldn't understand the PC card that was inserted. Regardless of the driver, it would say "Unrecognized hardware found." Running the Add New Hardware wizard didn't help. Manually installing the drivers didn't help. Switching between our Linksys wireless PC card, and our D-Link wireless PC card (and going thru the whole driver thing all over again) didn't help.

We plan to use the frame anyway. Either we'll connect an Ethernet cable to it for transfers, and put the images on the frame's hard drive, or we'll see if we can use a cheap USB wireless connector. We think these old laptops have only USB 1, as opposed to USB 2, and hope we can find a wireless USB stick for it. We could also try to fix the PC slots, or swap out just that component.

Occasionally, on booting up after being unplugged, the computer would have an issue with the BIOS, probably because we have no batteries for it. If we got an error on boot-up, we would just power down the computer (by pressing the push-button), and boot it back up. The next time, Windows would load fine. The BIOS didn't care if we didn't enter setup. It just wanted to warn us about things one time.

Mounting the Computer to the Frame

The key is to position the motherboard so it is not over the LCD panel as much as possible. This is clearly easier if you have a larger frame, with a large mat around the LCD panel.

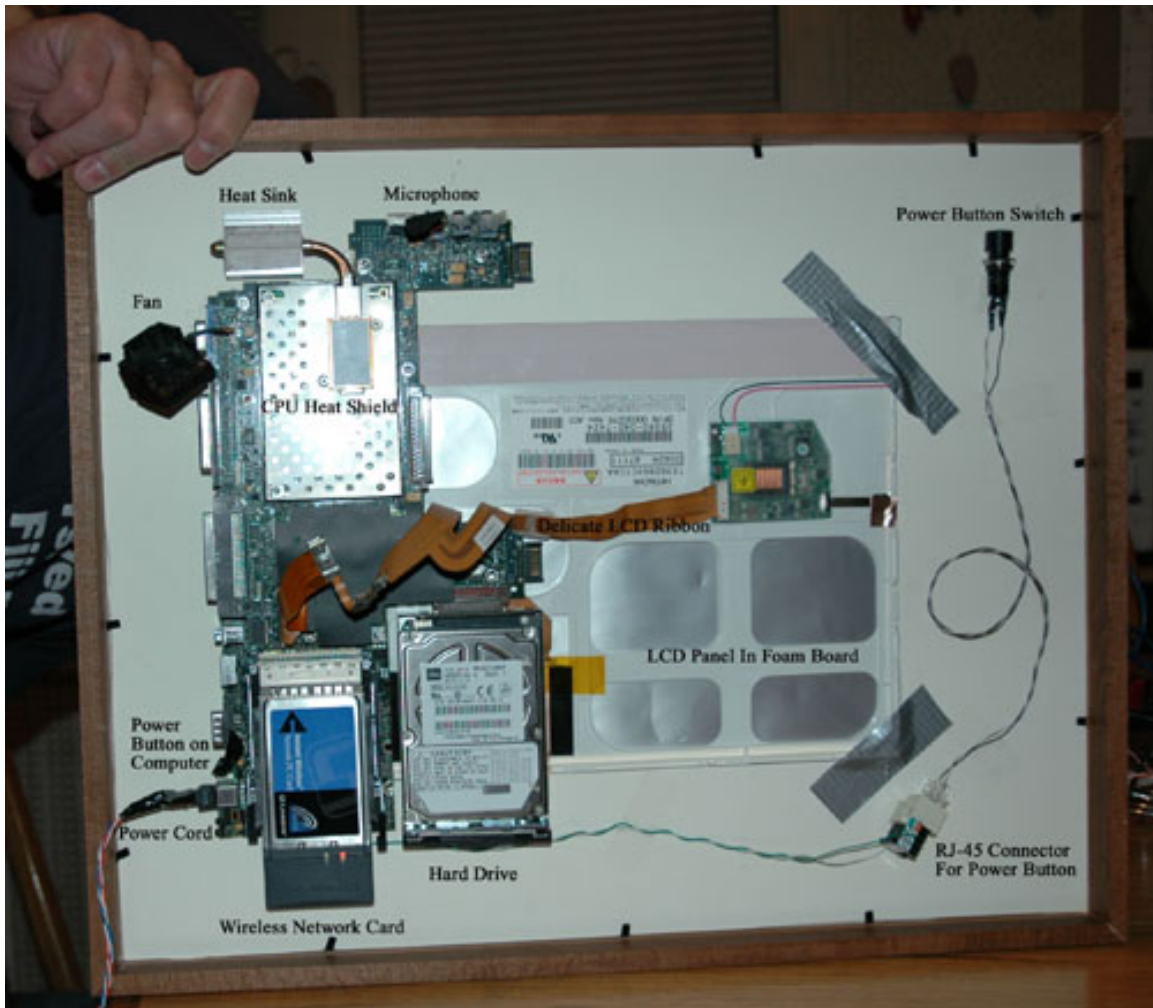
We simply re-used the kick screw sockets we took off the back of the motherboard. We embedded these into the foam board which was holding the LCD panel, glued them with liquid nails, laid the motherboard over these, and used other screws to hold the motherboard down over these kick screw sockets. For extra security, we'll probably screw wires across the back of the frame and across the top of the motherboard. People have also talked of using tape and glue. Others screwed the motherboard into the solid particle board that comes as the backing of the frame itself.



Here, the kick screw sockets are lying on their sides before being embedded into foam board.

We taped the wires of the on/off switch on the back, and taped the new pushbutton near the inner side of the frame. Later, we plan to place a tiny touch button on the top of the frame.

We had to unscrew the fan from the heat sink and angle it a bit, so it wouldn't stick out as much from the back. But we reconnected it to the motherboard and kept it on there. The fan has gone on occasionally on testing, when the pictures would change every 5 seconds, and is the only time the frame is at all noisy. When we got off testing mode, and lengthened the viewing of each picture to a minute or more, the hard drive and CPU didn't need to work as much, and the fan never seemed to kick on.



Tammy hung it on the wall carefully, much like hanging any other picture. The power cord (our four CAT-5 wires) drops down from the bottom of the frame. We will tape it to the wall and paint the wires the same color of the wall eventually. Right now, it doesn't bother us at all.

End Result

That's it! Oh'm'god! It works!

The frame in Tammy's office looks SO cool! We are especially proud every time we look at it. WE built that thing! And now our digital photos are not collecting digital dust in our hard drives. We're viewing them, as if they are real photos in a frame. In fact, someone looking at the frame wouldn't even know they were digital photos until the frame surprisingly changed its image! The resolution is that good. And the laptop screen is HUGE! It's a large image. Very nice! The thing just looks great. All we have to do is paint the power cord, and it will not be noticeable.





Now that we know what we're doing (for the most part), we can swap in parts from different computers, like the monitor of one, the hard drive of another and the motherboard of yet another. We may be able to score REALLY cheap laptops that way. We can buy one with a busted monitor, one with a bad motherboard, etc. And the time to build a new one will be minimal. The first one took forever as we tentatively performed each step without confidence. But the next one was done in a single evening. It took longer to load Windows into the hard drive than it did to build the entire second frame we made.

Pricing

Total price for all parts was about \$110 - \$120 per frame, give or take. It was:

- \$70 laptop with broken cord (no peripherals of any kind, just hard drive)
- \$18 frame
- \$7 to have the mat custom cut to our measurements and purchased
- \$3 foam board
- \$10 for a great screwdriver set at Walgreen's (but that can be useful for more than the laptop)
- \$20 for the RJ-45 crimping tool (strictly not necessary, either)
- \$6 for each RJ-45 connector set (socket and head). They were expensive!
 - We bought a 10 pack of each, sockets and heads, to save money.
- \$40 for the PivotPro software (there are probably other ways to do that)
- \$0.75 per pushbutton switch
- \$10 for old CD drive (we haven't actually bought that as of this writing)
- \$3 for Exacto knife, used to cut power cord and foam board
- \$20 for cold solder gun (any solder gun would work, though). We had solder
- A few bucks for a tube of Liquid Nails
- We had electrical tape and wire strippers
- We had the wireless cards lying around, and old CAT-5 cables we could rip apart
- Maybe 10 hours of time to do the first frame
 - We did it an hour or two a night over several nights
 - Less than half the time for the second one (including loading software)