

on the bus if you disconnect the hub. If this works, you can just leave the hub there until it is needed for other devices.

Having a hub in the front is valuable in many ways. You can use it to **connect keyboards and mice** [Hack #55], GPS receivers, **wireless remote controls** [Hack #56], or **Bluetooth adapters** [Hack #63], just to name a few.

### See Also

- “Power Your Portable Devices in the Car” [Hack #50]



## Build an in-Car PC

Having covered all the basics, let's look at how a U.K.-based IT manager put together his car PC.

My job involves a good deal of travel, so naturally I looked into buying a satellite navigation system when I was buying a new car. But the high cost and minimal features of the factory navigation system compelled me to look at computer-based alternatives.

At first I considered using a laptop with a GPS and PC-based navigation system, but laptops are clunky copilots at best. After a lot of online research, especially on <http://www.mp3car.com>, I found that I could actually build a small PC for the car that would not only give me a navigation system, but also MP3 and DVD playback, all usable though a nice touchscreen interface. Armed with this knowledge and the cash I had saved by not opting for the factory navigation system, I began piecing together my car PC.

### Choosing a Computer and Screen

To get started, I looked for a computer. Cost was a big factor here for me, and after some searching I purchased a used, preassembled 800-MHz VIA Mini-ITX system (Figure 4-20) from an online auction. The low-cost, power-efficient **VIA boards** [Hack #41] are by far the most popular motherboards for in-car computer use.

The first version of my car PC project used an LCD composite monitor attached to the TV-out port of my video card. I thus learned that using a standard LCD TV screen (with a composite connector) will result in an unacceptably low-resolution picture for anything but watching movies. If you think using a TV for a monitor on your home PC is bad, it's even worse in the car because the screen is so small.

As far as I am concerned, the screen is the most important part of the whole system. It needs to have high enough resolution that it is readable, looks



Figure 4-20. A Mini-ITX based computer

good, and is able to cope with the resolutions needed to run computer graphical user interfaces. Lilliput's (<http://www.newvision.com>) 7" touch-screen monitors [Hack #26] are by far the cheapest (less than \$300) and most popular screens for in-car PC installation, so that's what I went with.

I had to do some adjustment to get the sharpest picture on my Lilliput monitor. I invested in a PCI video card with 3D capabilities and TV out, and fortunately the card I bought was compatible with a utility called TVTool ([http://tvtool.info/index\\_e.htm](http://tvtool.info/index_e.htm)). The Lilliput has a native resolution of  $800 \times 480$  pixels, and TVTool was able to set the resolution to  $800 \times 484$  or  $800 \times 480$ , both using the 75-Hz refresh rate. This put Windows in a true 16:9 (wide-screen) resolution and eliminated flickering on the screen. The onboard video of most VIA boards can't display  $800 \times 480$ , but the Lilliput can display an  $800 \times 600$  image—it will just look compressed vertically, which you may be able to compensate for in your application software.

### Installing and Mounting the PC and Screen

While a custom-fabricated dash installation of the screen is a very popular option, one of my goals was to have a PC that I could move from car to car. On the Lilliput units, the USB wires for the touchscreen and the VGA input are all contained in a single cable, which means that if need to I can simply

unscrew the screen from the dash, unplug the cable, and quickly place the screen out of view from prying eyes.

To mount it on the dashboard I used a special mounting bracket from Dash-mount (<http://www.dashmount.co.uk>) in the U.K.—the bracket needs no screws, so when I sell the car there will be no holes left in the dash. To attach the screen to the bracket itself I simply used the thumbscrew that came with the monitor, slightly drilled out the center hole of the bracket, and added some sticky rubber pads to hold the screen in position (Figure 4-21).



Figure 4-21. My touchscreen mounted to the dash

I decided to install the computer itself in the boot (that's the trunk, for all you Yanks), still keeping to the goal of minimizing the amount of modifications I made to the car (i.e., drilling holes). To wire up the computer, I needed power [Hack #42], ignition (ACC/KEY 12V), a very good ground, sound to the head unit [Hack #14], and VGA and USB extension cords. For the power I used a three-pin “Euro” mains socket and plug and a 13A main cable. I ran the power down one side of the car and the sound and video down the other, to prevent interference [Hack #17]. For the VGA, I bought a 10-foot extension cable from a computer store. Finding audio cables was easy, but I had to fabricate the USB extension cables by soldering a USB socket and plug to CAT4 networking cable.

The benefit of a trunk install is that would-be thieves are unaware of the computer's existence. However, I needed a method to stop the computer

from sliding around the trunk while I was driving that didn't involve modifying the vehicle. The answer came when I was looking at my brother's new car. He was in a rush to get his stereo and amps into the car, so he had used Velcro to put them in place. This held the amp to the carpet in the back and also let him quickly remove it at night. I decided to try this myself, so I went down to the local market and bought some Velcro. Once I got it home, I laid it out on the floor in a cross and placed the CPU on top of it. Then, making sure that the plastic hooks were facing down, I measured and cut them as needed. When finished, I simply took the whole unit, with the Velcro wrapped around it, and stuck it to the carpet in the boot (Figure 4-22). Success! And although I planned to replace it with a custom-built metal case drilled into the side of the car, I have never yet had cause to change the design.



Figure 4-22. The power of Velcro

One of the questions you may be asking yourself is, “Won’t the hard drive get damaged when I drive over a bump?” It’s possible, but I think in the several years I have been following car computers I have only heard about this happening once or twice. Still, there are ways to minimize the possibility, two of which I have tried myself. The first is to soften the impact by placing rubber in between the hard drive and the mounts where the screw attaches to it. (I got this idea from Hewlett-Packard, who used it in some of their desktop machines that I worked on a lot a few years ago.) The second option is to use a laptop (2.5”) hard drive. Although they tend to be smaller and slower, the advantage you get is that they are built to take more shock and vibration than conventional 3.5” desktop drives—and the speed of laptop hard drives today is quite sufficient to play back audio and video.

## Mounting Your Car PC

Each car will pose its own challenges with regard to mounting a CPU. You have to consider ventilation, heat dissipation, access, security, removal, and what happens when you sell the car.

Facing the trunk, sedans have a nice flat seatback to which you can securely mount a 0.25" or thicker board. Any car audio shop can install the board for you if finding anchor points in the seatback proves too challenging. Measure the board to be a little bigger than your car PC, flush with all the sides except the cable side of the box. On that side, let the board extend 6". The extra space lets you secure the cables nicely for better presentation. Extend the board further if you need to mount other devices, such as power blocks or fuses. With the cover removed from the case, you can use four wood screws to penetrate the case floor (watch out for things like computer parts and wires) and mount it to the board. Using rubber feet between the case and the board can add a little vibration dampening, which will make your hard drive happier and extend its life.

Another good place for car PC installation is under the rear window, in the trunk. That deck is often made of metal, and with a few *short* screws a board can easily be fit to it. Long screws might penetrate all the way into the cabin space, and that's not a good look.

Hatchbacks are trickier, as they have fewer suitable surfaces. Depending on the size of your car PC, you may be able to wedge it behind the rear-side panels (which often house a tire jack or CD changer). You can also look in the front passenger footwell, under the dash. If the space is not overwhelmed with heating/air conditioning hardware, a small PC may fit there.

Installing your devices under a seat is a good way for them to get kicked, wet, and dusty, but this is an extremely popular option for both amplifiers and car computers. Under rear seats, heat and ventilation can be issues; however, the most popular car PCs deal with this environment just fine.

A lot of people with very customized cars use that big, inviting circle in the bottom of the trunk where a spare tire used to live. Pickup trucks often have a nice space behind the driver's seat or in an extended or crew cab, behind the back seats. That flat, tall space makes a perfect perch.

But what about the ever-present SUV or the humble minivan, with all their cubic feet of space? Unfortunately, all of that great cargo space is exposed. Finding places for a small computer in these vehicles will prove to be a little challenging. Check the usual spaces—under the passenger seats, in the rear quarters, and in the front passenger footwell—but also check right in the middle of the car. Larger SUVs often have a large center console that sits up high. There may be space under it, or in it. Alternatively, you can always create a custom box and mount it on the wall, behind the wheel wells and toward the back.

—continued—

As there will be a different solution for every car, truck, or SUV, think creatively, and consider the materials you have and can acquire as well as the level of difficulty for each mounting place. The space you have to work with in your particular vehicle should help you decide what size and shape of computer case you purchase.

—Lionel Felix

## Powering the PC

After looking at the various [power supply options \[Hack #42\]](#), I decided to go for a highly recommended off-the-self option: the 90W supply from Opus Solutions (<http://www.opussolutions.com>). I knew that if I skimped on the power supply I could come back to my car to find it with a dead battery, or possibly even fry the machine.

Although it was slightly bigger than I expected, it was still smaller than its 150W bigger brother, and it fit very nicely in the unused hard drive bay in my Casetronic case. The Opus cost a fair bit more than many of the other options, but I felt that the extra expense was worth it because it gave me configurable shutdown options and low-battery protection for the car, as well as a clean ATX power output.

## Peripherals and Controls

The primary interface for controlling the operation of my car PC is through the touchscreen and the custom skin I've made for the [FrodoPlayer software \[Hack #75\]](#) (Figure 4-23). I have also configured a [wireless remote \[Hack #56\]](#), so that my passengers can control the music playing from anywhere in the car.

## Audio Connection

Once I had installed my car PC, I had to decide how I was going to [connect it to my existing car audio system \[Hack #14\]](#). I tried using an FM modulator, but the sound just wasn't clear enough for me, so I purchased a Kenwood head unit (KDC-W6527) that had auxiliary audio inputs and even worked with my existing steering-wheel volume controls.

In addition to connecting my car PC to the radio, I [connected a USB radio to my car PC \[Hack #19\]](#). I used the D-Link DRU100, and I installed the drivers from a program called Radiator (<http://radiator-fm.com.ru/indexuk.htm>), as they are more stable and work better with Windows XP than the ones that





Figure 4-23. My touchscreen interface

came with the DRU100. With the USB radio, I can tune radio stations and set presets via the same touchscreen interface that controls all my audio.

## Networking

One of the popular solutions for getting content from your home PC into your car is **WiFi** [Hack #64], but this approach is much slower than good old network cable. Also, because car computers are designed to shut off soon after the car turns off (to save the car battery), if you download content via WiFi you actually have to leave your car on while your music downloads. I tried using WiFi anyway, but my house tended to absorb the WiFi signals too much. Although I could get a connection outside, when I tried to copy large amounts of data the wireless connection dropped a lot of it. To solve this problem, I installed the remote desktop program VNC (<http://www.realvnc.com>) on both the car PC and my laptop. When I need to copy content to the car PC, I simply use a crossover network cable—this solution cost me far less than buying wireless cards and a WiFi point, and it transfers the data quicker.

If you do want to **connect to the Internet while you're out and about** [Hack #62], you'll more than likely need a Bluetooth adapter, a Bluetooth phone, and a contract that allows you access to a GPRS data system. You may find this useful for accessing certain web-based travel data sites (such as the U.K. Traffic Master system), so you can **plan your route before you leave your departure point** [Hack #65].

## Frontend Software

While Linux options exist, I found that most of the free frontend applications developed by and for the in-car PC community are Windows XP–based. The various car PC frontends tend to carry out the same functions, but in different ways. Most of these applications are also *skinnable*—that is, you can customize the visual look of the user interface to suit your taste. As many of them are under continuous development, I think it’s a good idea to test several options before you make your choice. The main players in the freeware world that I looked at were FrodoPlayer [Hack #75] (<http://www.frodoplayer.com>) and Neo-car Media Center [Hack #74] (<http://www.neocarmediacenter.com/?language=EN>). I found FrodoPlayer to offer the best options for visual customization.

After I installed all the supporting utilities, I installed FrodoPlayer and set up my preferences (such as my music and movie directories). I also placed a FrodoPlayer icon in my startup folder, so that when my PC started it would be the first application that was shown (hiding the Windows XP interface).

When choosing a skin, bear in mind that a touchscreen can be very hard to read in sunlight, so a darker skin can help the characters stand out better. I adapted one of the more well-known FrodoPlayer skins from Febsperanza (<http://febsperanza.3plast.com>), and once I’d changed the text and the “glow” of the buttons to match my dashboard color, I had an interface that looked like it came straight from the manufacturer (Figure 4-24).

## GPS/Navigation

The first GPS software I used was Microsoft’s AutoRoute, a quick application that supported my GPS system. Later, I switched to Destinator [Hack #71]. Destinator is one of the few PC-based systems that looks as good as factory navigation. It gives you touchscreen menus for planning your journey and excellent 3D views, just like a factory-installed system (Figure 4-25). More and more car PC applications are now supporting it.

I’m on my second GPS receiver now—my first one worked well, but it was purple and round and just didn’t look good on my dash. I originally ran a single USB connection to the front of my car, with all the devices going into a nonpowered USB hub [Hack #51]. My new GPS unit is a power hog and demands more power than that USB hub could provide, though, so I ended up running a separate USB cable just for the new GPS device.

## Movies and Music

Beyond navigation, the main benefit of my car PC is that I can play all of my music and digital videos in the car. I have been slowly converting all of my



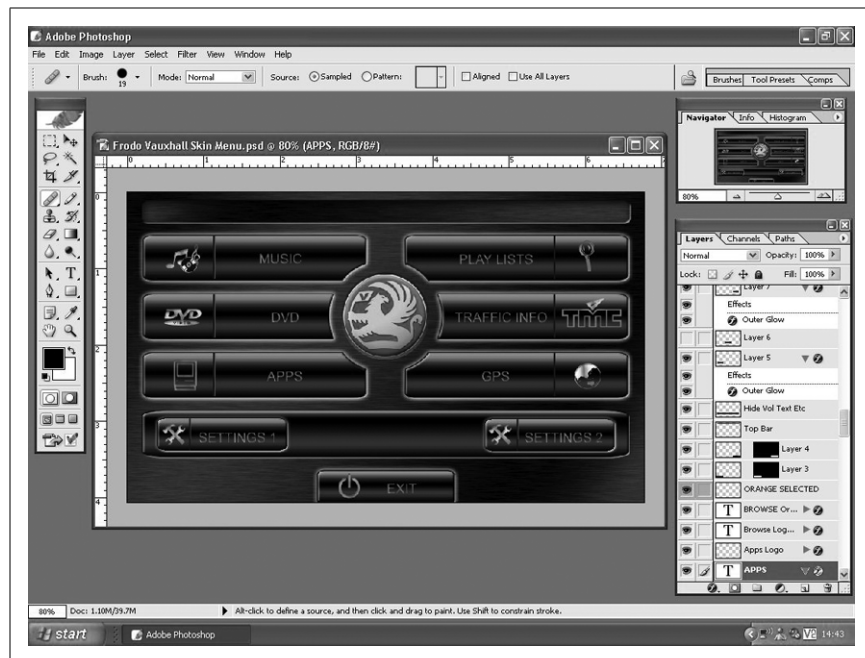


Figure 4-24. Designing my FrodoPlayer skin



Figure 4-25. Destinator's 3D navigation interface

LPs and CDs to MP3 using CDex (<http://cdexos.sourceforge.net>), and I have a collection of music videos as well. When I finally got my PC fully installed, with my entire music collection available at my fingertips, I knew it was worth all the effort.

### Encoding Your Music Collection

Encoding your music collection from CD is a lengthy process that may take you months. Once you have all of the MP3/OGG/WMA files in the same place, take some time to spruce them up a little. Tag & Rename, an application from Softpointer (<http://www.softpointer.com/tr.htm>), can handle your ID3 tags one at a time or in bulk. With good ID3 tags, finding songs is much simpler and more straightforward. This app won't just help you normalize and standardize the naming conventions in your collection—it will also identify mystery albums where no names were given to tracks, and it will download and add album art to your tracks and albums.

—Lionel Felix

### Conclusion

A car PC is a great thing to have, and it gives you features available nowhere else. If you put in the effort, you can create a unique, customized system that does exactly what you want and offers far better value than any off-the-shelf solution.

When you're planning and building your car PC, be sure to take advantage of the many online forums. These forums are extremely useful to the car PC community, as they enable people from all over the world to share ideas and hints, and even arrange local meetings to show off their work. I have attended a number of U.K. meets, and I've found them to be excellent opportunities for enthusiasts to meet up, see what others have done, and make new friends.

### See Also

- <http://www.letscommunicate.co.uk>—Terran Brown's web site
- <http://www.pricepc.com/html/carpc.php>—A sampling of car PC installations and pictures
- <http://www.via.com.tw/en/initiatives/spearhead/Mini-ITX/car-pc.jsp>—Several more car PC installations, using VIA motherboards
- <http://www.mp3car.com>—A U.S. car PC forum

- <http://www.digital-car.co.uk>—A U.K. car PC forum
- <http://www.cpcd.de> and <http://www.car-pc.info>—German car PC forums
- <http://www.carmedia.org>—A French car PC forum

—Terran Brown



## Build an in-Car Macintosh

Check out how one programmer used OS X and a PowerMac G4 to meet his in-car computing needs.

Several years ago I got a job in Holland, and I needed a comfortable car for almost-monthly trips to the Czech Republic. I purchased a 1993 Tatra T613-4Mi sedan with a rear-mounted 200-HP V8 engine. Ironically, although the car I purchased had been made for the Frankfurt auto show and was originally equipped with fully digital controls, a handful of computers, and features such as voice synthesis, the factory had replaced all this equipment and rewired it with more traditional controls after the show. The moment I bought it, I decided that a computer *had* to be put back in. I started to design my Tatra computer in the summer, and by Christmas I had a working installation.

The main features that I wanted my in-car computer to provide were a navigation system and the ability to play my MP3 collection—anyone who needs to make 1,000-km trips every month or has ever been lost in Copenhagen can understand the need for a lot of music and a good map.

Of course, I could simply have purchased dedicated navigation hardware (and a head unit that plays MP3s), but I was not very excited about the prospect of spending several thousand euros on a dedicated hardware solution and then having to wait for the manufacturer to release the maps that I needed of the Czech Republic. The use of a standard computer gave me much more freedom in terms of the configuration of the system and of potential software and hardware upgrades.

During the design and construction of my mobile Mac, I also decided to add some functionality that I hadn't anticipated, including communication with the engine controller and an on-board microcontroller for basic telemetric data.

## Choosing a Computer and Screen

My first idea was to use an LCD iMac, and build it into the original dashboard of my Tatra. The base unit was supposed to be placed within the dashboard, and the display with its holder outside. This idea had two basic flaws: the iMac's 15" screen is really too big for most dashboards, and its