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How to use avr programmer

×Sorry to interruptCSS Error Recently, I have been using a lot of AVR chips and I faced few problems regarding burning the code on these chips using commercial AVR programmers. So, I decided why not building my own AVR programmer and get rid of all of this hassle. And, why not customize it according to my needs. Tiny AVR Programmer Background Today, we will take a look at how this board is designed, and I will take you on a journey on how each component is working in this design. If you have just an AVR chip, you need something to program it. the most common way is through ICSP(In-circuit serial programmer). simply, it's a board that has 6 pins usually a 0.1" pitch header that can talk to your AVR chip through the SPI protocol. At the other end, it also can talk with your PC through the USB protocol. So, after compiling your C code using avr-gcc, the programmer board will take and send it to your AVR chip directly. You can think of it as a bridge between your PC and your AVR chip. I did my research for AVR programmers and I found a lot of cool resources. this one specifically caught my eye. It's the FabOptimus AVR programmer built by Ali Shtarbanov which built on the FabISP programmer built by prof. Neil from MIT Media Lab. the FabOptimus documentation is very good and easy to follow if you are a newbie. I decided to make a very small modification to the FabOptimus AVR programmer since it doesn't have a power indicator LED, I wanna add one! FabISP bt Prof. NeilFabOptimus by Ali Shtarbanov PCB Design And Circuit In-depth Analysis First, we need to understand how this board is designed and how each component in this circuit is behaving. FabOptimus Original Schematic and Board Layout This AVR programmer is based on the ATtiny44 AVR chip which by default it comes blank, no code or anything is uploaded to it like any microcontroller chip you buy. Since we are building an AVR programmer, we need to upload a very specific firmware to the ATtiny44 chip that tells exactly the role it should follow and execute. Simply, which is sending some hex files to other AVR microcontrollers. This firmware is called FabISP firmware(more on that later.) So, we need to be able to upload the FabISP firmware to the programmer AVR chip then disable the possibility of reprogramming it. To be able to upload the FabISP firmware to the programmer AVR chip we need to pull its reset pin to LOW(0 volts), and to disable the possibility of reprogramming it once it has been programmed, we need to pull its reset pin to be always HIGH(5 volts). So, we need to design the circuit in such a way that the reset pin is HIGH(5 volts) by default. But, once another programmer is connected to it, it can pull the programmer AVR chip reset pin to LOW(0 volts). That's why we are using a 10k ohm pull-up resistor on the reset pin. As you notice the ATtiny44 chip reset pin is connected to the RST pin on the ISP pin header through a 0 ohm resistor. after uploading the firmware to the ATtiny44 chip we will remove this zero ohm resistor to disable the possibility of reprogramming the board again. Since we need to use our programmer board to program other AVR boards, our programmer board will need to be able to provide the reset signal to the other AVR boards that we need to program. So, we are also connecting an I/O pin from the ATtiny44 chip to the RST pin of the ISP pin header to provide the reset signal to the other AVR chips that we need to program. To reduce any high frequency noise or any voltage drops coming from the power supply we are using 1uf decoupling capacitor between the VCC(5 volts) and GND. We also using a 20MHz resonator as a clock source for the ATtiny44 chip instead of it's internal clock to achieve more accuracy. We are using two 3.3v Zener diodes as voltage clippers to regulate the voltage from 5v to 3.3v. According to the V-USB and USB specifications, the voltage on the USB data lines should not exceed 3.3v. Also, we are using a 1.5k ohm pull-up resistor on the D- pin of the USB to make it recognizable as a low-speed device on the host side. Finally, I made a simple edit to the board. I added a power indicator LED to the board. It's a best practice to disconnect the VCC pin on the ISP pin header to make sure that the AVR programmer is not attempting to supply power to the board that we want to program. the board that we want to program should provide its own power. If we didn't disconnect the VCC pin on the ISP header, the AVR programmer and the board being programmed will draw their current from the USB port(from your computer). if your USB port can't supply that much current or at any short circuit circumstances, that may cause a huge problem to your computer. PCB Manufacturing As you can see, I fabricated this board using a CNC milling machine at Fab Lab Egypt. But, if you are searching for high-quality PCB manufacturing with a solder mask and silkscreen at a very fair price and fast worldwide shipping with no minimum requirements you may order as small as 10 pieces for 5\$. you can order yours from PCBWay. You can also support me by just ordering this board from my link. PCB Ordering We love open source. You can download all the board source files from my Github repo. PCB Soldering And Components Placings Part NameQuantityATTINY44A microcontroller chip1CER RESONATOR 20.00MHZ SMD1MINI USB2.0 5POS16 Positions Header Connector 0.100" SMD1CAP CER 1UF 50V 10% SMD 12061RES 10.0K OHM 1-4W 1% 1206 SMD1RES 1.0K OHM 1-4W 1% 1206 SMD1RES 499 OHM 1-4W 1% 1206 SMD2RES 100 OHM 1-4W 1% 1206 SMD2DIODE ZENER 500MW 3.3V SOD123-2LED Blue CLEAR 1206 SMD-1AVR Programmer Board Components Uploading The Firmware To The Programmer To upload the FabISP firmware to the FabISP AVR programmer board, we need another programmer to help us upload the firmware to our FabISP board. we will use an Arduino UNO board as an ISP programmer and we will connect it to our FabISP AVR programmer board. First, we need to upload the "ArduinoISP" sketch to the Arduino UNO board. You can find that sketch from files->Examples->ArduinoISP->ArduinoISP. After uploading it to the Arduino UNO board. Let's connect our FabISP AVR programmer(Target) with the Arduino UNO board(Programmer). D10(Arduino) -> Reset (Target)D11(Arduino) -> MOSI (Target)D12(Arduino) -> MISO (Target)D13(Arduino) -> SCK (Target)GND(Arduino) -> GND (Target) OK now that you have learned all about how programming works in theory, its time to determine what sort of programmer is going to work best for you Comments? Suggestions? Post to the forum! There are easily a dozen programmers out there. I'll cover the 4 major types: Simple/Basic/BitBang programmers ISP smart programmers Development boards No-programmer (Bootloader) Simple programmers are very inexpensive and very simple. They connect to a serial port or parallel port directly and then the computer software twiddles the port to send data to the chips. A parallel port programmer looks something like this: It plugs into the parallel (printer) port of a computer You can see the silver part plugs into the parallel port, and then theres a cable that plugs into a 10-pin ISP header A serial port programmer looks something like this: Very similar to the parallel port programmer, but plugs into the serial port Some have a buffer chip to disconnect the programming pins when the chip is running so that it can use the programming pins for other things. Without a buffer you may have to remove the programmer after the chip has been programmed. I suggest these for people who are just starting out and are doing very simple stuff but strongly suggest a quick upgrade to a smart ISP programmer or development board. Pros: Ultra cheap (\$10-\$20), easy to understand, because the software does everything there's no risk of 'programmer incompatibility or upgrades' Cons: Requires a PC with the ports, Macs can't use these, if you're working on high voltages (more than 5V) you could zap your port, multiple standards for programmer interface. You can buy such programmers in the adafruit webshop. These programmers plug into the serial port or USB port, and have more brains than bitbang programmers. They are also more likely to work, and have some nice features. The most common programmer is the AVRISP and the AVRISPV2. Both look something like this: Photo courtesy EvilMadScientistLabs There's a jack on one end for a cable and the 6-pin and/or 10-pin cable comes out the other. The AVRISP v1 had a serial port jack and the v2 has USB. The v1 has both cables, the v2 has only 6-pin. AVRISPV2's are available from Digkey.com or Mouser.com for \$36 or so I really liked the v1 but it was discontinued and the v2 doesn't support 10-pin cables so I designed my own programmer called the USBtinyISP, you can build it from a kit for about \$20. Read more about it here. There's a lot more ISP designs out there, many homemade. There are dozens of development boards out there all slightly different, so I'll cover the two that are the most popular (and fairly inexpensive) and are officially endorsed by Atmel. The first is the STK500, which for \$80 is quite a beast. It supports pretty much every chip Atmel makes with all the various sockets. It has buttons, LEDs, an adjustable clockspeed oscillator, etc. This programmer is supported by AVRStudio, which is Atmel's programming environment. Since it is the 'defacto' programmer, the programming method it uses to talk to the computer (Called the STK500 protocol) is also a standard. Its got a bit of a learning curve but lots of people use it. You can buy it from Digkey or Mouser. The nice thing about it is you get a huge dev board, it has sockets for all the chips, as well as a programmer. The sad part is that it only has a serial port so you'll need a USB serial converter. The second is the AVR Dragon which is an emulator as well as a programmer. It is used more like an ISP than a development board, it has connectors for both 6 and 10 pin headers. I havent had much play-time with it but people say its nice, and its only \$50 Note that there are no sockets for the chips. In recent years, microcontroller designers have added the capability for the chip to program its own flash (often called self-programming). What this means is that a program burned on a microcontroller can actually change its own program. In most cases this is not a good idea, a program can overwrite itself, damage itself, and/or cause the microcontroller to freak out. However, in certain cases this can be a benefit. Take, for example, a small program that is burned into the chip that can communicate with a computer through a USB or serial cable and allow the computer to download new firmware without the use of a programmer.When you 'update the firmware' on your MP3 player or cell phone, this is whats happening. For example, Arduino use a bootloader that is programmed into the chip at the Arduino factory. The bootloader is protected so that it can't overwrite itself. To upload code to the Arduino, you use the Arduino software which is smart enough to recognize when an Arduino is connected. Bootloaders are great, but you need a ISP programmer to put the bootloader on the chip the first time if you're buying the chip from Digkey or Mouser. Its a bit of a chicken-and-egg problem. Bootloaders also don't let you modify the fuses (discussed later) and they take up a portion of the flash memory so uploaded programmers must be smaller. In general bootloaders are great for starting out with but I find its important to have some way to program the chip so that you can put the bootloader on and maybe modify the bootloader or fuses. I won't be using bootloaders in these examples, but will assume you have an ISP programmer as they are more universal. Later on, you can always add your own bootloader. April 27, 2012 11:17

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