

Experiences with a CNC machine

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Chinese made CNC machines became available at an affordable price locally and I bought one. It came in kit form, in a remarkably small box with all the components neatly packed and it was fun putting it together. It used an Arduino Nano to control it and I was familiar with programming such devices and had no problem loading the program which came on a USB memory stick.

Soon I was experimenting with the milling and drilling operations and engraving and cutting thin materials with the 2.5W laser.

After about a month the machine suddenly stopped working and I could see a component that had exploded on the electronics board. I think it was a diode in a switch mode regulator that had blown. I managed to replace this component but it was an obvious repair and so I contacted the supplier who promised to supply a new board, but this never materialised.

So I decided to make my own board and I went through the procedure of designing and making a new printed circuit board several times.

Then one day I was drilling holes in a pcb and suddenly I saw that the machine was drilling holes in positions shifted by a small amount from the designed positions. I concluded that vibrations in the drill motor had caused a stepper motor to add or subtract some steps and this caused the error. I checked the motor and found that it ran smoothly if I removed the large nut that clamped the chuck. I had no means to balance it but took a chance and drilled some holes in the nut to try and balance it and did manage to reduce vibrations a little.

But I also found that when I ran the motor on a variable power supply, at certain speeds there would be resonance between the motor and parts of the CNC machine, so I decided to put a speed control on the main board so I could run the motor at speeds that

avoided such resonances. So I designed a pulse width modulation system to control the motor speed but that was a disaster because the sudden switching of an inductive device with the PWM supply, produced huge spikes on the supply voltage that interfered with the rest of the electronics. So I replaced the PWM supply with a switch mode regulator that provided a clean voltage to the motor regardless of the speed.

Then one day my neighbour asked me to engrave his business logo on some plastic panels and I put the laser to work. The 2.5W laser was way too powerful for that and melted the plastic too much and made a messy job. So I read up on the way the laser was controlled and found that the laser diode was fed by a constant current source. I quickly made an external variable constant current source which worked over a small range, but when I reduced the current too much, I found that the laser's beam went out of focus.

So back to the drawing board and I designed a PWM system for the laser that could control the power between 1% and 99% and could then engrave on plastic with only about two or three percent of full power and the engraving was then satisfactory.

I reconciled myself with the thought that I will probably be forever changing something on the CNC machine and so I designed a main board in such a way that the different components could be unplugged and replaced if I wanted to. I now have a USB to TTL board for the connection to the computer, a switch mode regulator for the motor, a pulse width modulator power control for the laser, and an Atmel 328 integrated circuit that replaces the Nano.

Once I am satisfied that I have a workable board, I may have it manufactured commercially to make it look good.

I bought a cheap 3D printing tool that is supposed to be used in a hand held fashion and will attempt to mount it on the CNC machine in order to do a little 3D printing although I will be limited to making items not more than 40mm high, but this could already be useful.

I read quite a lot about other types of CNC machines and get the impression that some of them could be more precisely made than my low cost one. There are models that can do 3D printing as well. There are also laser cutting machines that use lasers much more powerful than my little laser, I believe one can get diode lasers up to 15W but you have to use CO2 lasers if you want to go higher power. Such machines are mounted in enclosed cabinets so that exhaust fans can be used to get rid of smoke, because after all, it is a burning action that takes place. I have a friend who has a 60W laser that can cut through plywood that is 3mm thick, but I also know of a business where they can engrave on stainless steel, that must take some power!