CNC Shark

by Allen Barrett

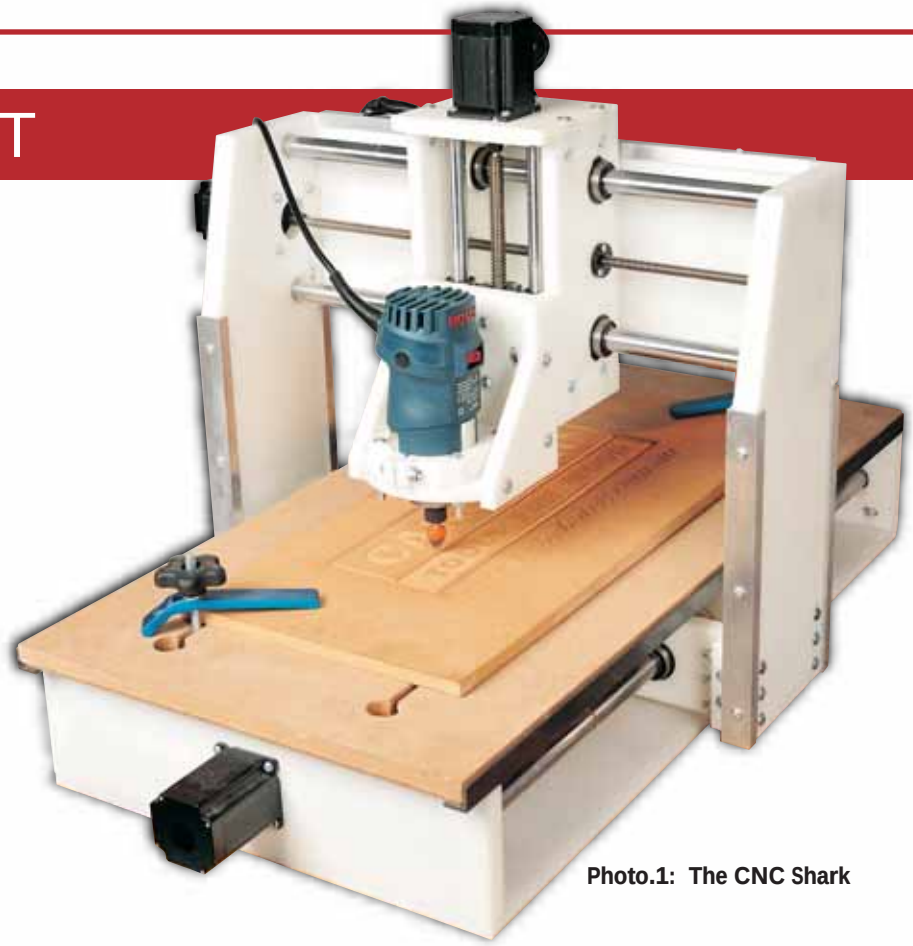

Photo.1: The CNC Shark

In the past, most of the computers that woodworkers have used in their workshops have been dedicated to a particular purpose. Like the fuel management computers in a modern car, the computer in, say, a Festool cordless drill is only seen in its effect upon performance and requires no computer knowledge on the part of its user.

The first thing that needs to be said about the *CNC Shark* (and its larger brother, the *CNC Shark Pro*) is that the wider use of Computer Numerical Control machines in woodworking is going to push the boundary. Both recreational and professional woodworkers are going to have to acquire some specialised skills in performing operations on a computer.

Fortunately, having spent a couple of days working with the *CNC Shark* (Photo.1) and its associated computer software, I believe this is unlikely to prove as daunting as some may imagine.

Anyone who has used a computer for functions such as wordprocessing or Internet access, should have the entry level skills needed to achieve useful results from the machine. In fact, from unpacking the *CNC Shark* (and reading the basic instructions!) to finishing the first project, will probably take no more than a few hours.

As will be remarked on again later, this basic work on the machine will reveal no more than the very tip of the proverbial iceberg, for even a modest exploration of the possibilities offered by the *CNC Shark* will take very, very much longer.

The USER Reports in this magazine generally begin with a description of the tool or machine, followed by comments on how it works and how well it performs. That is the way I've written my previous Reports on the assumption most readers would be aware of the main features of the product.

In this instance, however, there may be many who are not exactly sure what a particular kind of CNC machine can do and how they might use it in a woodworking workshop.

Computer Numerical Control for Woodworking

The *CNC Shark* is specifically made for woodworking (though it can also be used with some metals and plastics). The working head of the machine consists of a vertically aligned router which can be moved throughout a volume of approx 600mm x 300mm x 100mm under the control of a computer program.

The maximum movement of the router in the 'y' direction (ie. down the length of the worktable), is 24" (approx. 609mm) while its maximum movement in the 'x' direction (ie. across the table), is 12" (approx. 305mm).

These measurements therefore determine the maximum size of material that can be worked by the machine. The maximum length of the 'z' coordinate (the up and down movement of the router) is 4.25" (108mm).

Most of the work done by the machine is likely to be on material under 50mm thick and the depth of cut will usually be substantially less than this. (The *CNC Shark Pro* is the same in all respects as the *CNC Shark* except that the maximum size of material that can be worked is approx 600mm x 600mm.)

When a suitable cutter is placed in the

Photo.2: As shown by this photo taken during actual operation, little dust is produced but dust extraction is still advisable

Photo.3: Threaded rods drive the router carriage along three axes — traverse speed can be varied to suit material and project

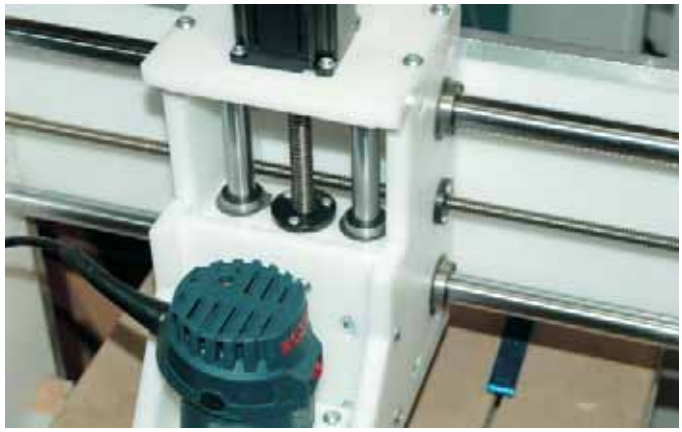

Photo.4: VCarve provides tools to create, manipulate and view designs, calculate toolpaths, estimate cutting times, and generate code to drive the *CNC Shark*

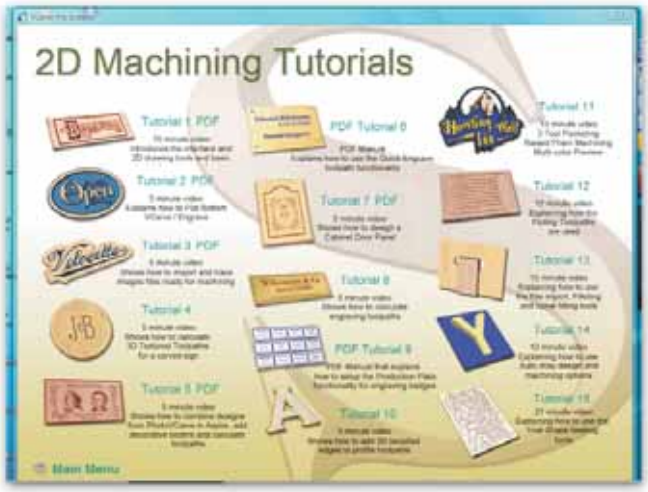

Photo.5: The VCarve program is accompanied by 12 tutorials which cover a wide range of projects that can be undertaken using the *CNC Shark*

chuck of the router, it can be used to cut/carve a pattern into the top surface and/or around the sides of a workpiece. (It can also be made to drill holes of virtually any shape in a workpiece, then carve the inner surfaces of these apertures.)

The pattern can be generated on any modern computer of the user''s choice employing a software package that is supplied with the machine. The file created by this software is fed via a standard USB cable into the machine's on-board computer which then directs the router's movements.

The machine itself will be discussed later but for the time being, it may be viewed as simply the production end of the process, all the decisions being made while the pattern is being devised.

The pattern may consist of letters, lines and textured areas which can be of varying depths — all produced by the cutter inserted in the chuck of the machine's on-board router. Some designs may call for more than one cutter to be fitted (sequentially) as the job progresses.

It will be obvious that the ability to make letters and lines and to work quickly, means that the *CNC Shark* provides a fast, convenient method of making residential or commercial signs that are cut (machine carved) in relief into a blank workpiece. (While cutting speeds are reduced in metal, it is possible to use the *CNC Shark* to engrave conventional brass nameplates.)

Special facilities are available for occasions when a large amount of waste must be removed to create a fielded area (referred to as a 'pocket'). (See Photo.9.)

The machine can also be used to create textured areas and this leads to a particularly interesting capability — the carving of low relief portraits or other similar illustrations. (See Photo.8.)

While signage is the first application of the *CNC Shark* that comes to mind, closer acquaintance with the machine reveals many others. For example, the machine might be used to carve one or more designs on panels used in the construction of doors. Imagine a kitchen with panelled doors, each bearing a design which is unique to the owner — a favourite flower, perhaps, a stylised landscape, or maybe a theme arising from the owner's occupation or interests.

The wall panelling of a den or study could be treated in a similar manner, with results ranging from muted or subtle through to imposing and dramatic.

But it's in work areas that are closer to the origins of CNC machines that many woodworkers will find the most exciting possibilities. These include the high speed production of components for items such as wooden geared clocks, clock cases, decorative boxes and toys.

The rapid repetition of precisely made project parts allows consideration of production runs that would be unthinkable without the power of a CNC machine.

It needs little imagination to realise that the *CNC Shark* offers many interesting and potentially rewarding commercial opportunities for professionals, recreational woodworkers and collectives such as woodworking clubs and schools.

Equally, however, there are sure to be many woodworkers who will be satisfied to simply enjoy exploring the *CNC Shark's* capabilities.

My short time with the machine demonstrated that while it may take only a few hours to get to the stage of producing worthwhile results, every project encourages further investigation and the variety of work that can be made appears almost endless.

The Software

There are two software packages required to operate the *CNC Shark*. One of these provides the user interface for the

Photo.6: Letters cut in woolly Meranti show minimal chipping and some furring at the edges — note slight discontinuity on the right lower side of Q (see text)

Photo.7: Selection from a list of wood species and other materials allows presentation of a realistic 3-D view of the finished design

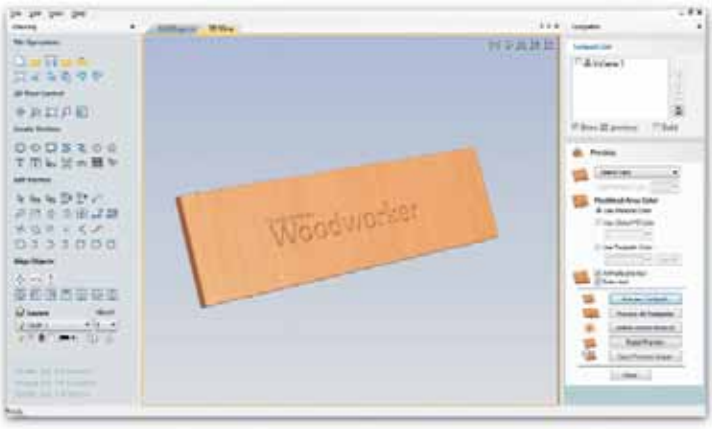

Photo.8: The texturing abilities of the *CNC Shark* can be extended to the carving of portraits

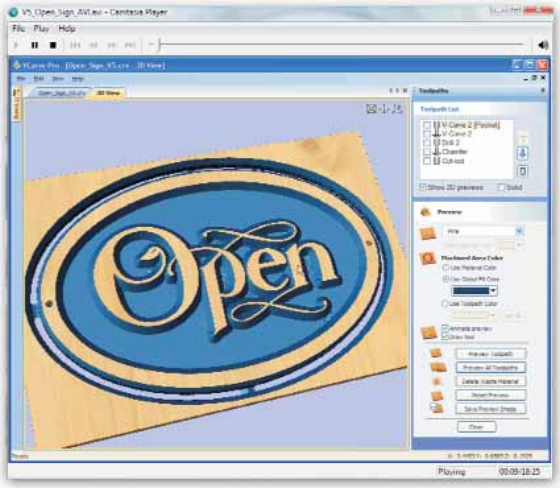

Photo.9: VCarve provides facilities to deal with large fielded areas or 'pockets'

machine and will be dealt with later.

The other consists of the *VCarve* program, a set of tutorials and a comprehensive manual, all supplied on a Compact Disk.

The *VCarve* program provides the 'tools' necessary to create designs (part or all of which may be imported from other programs), pre-view these designs in 2D and 3D, create the one or more toolpaths necessary to execute the design, calculate cutting times and output the toolpath instructions in a form (G-code) that is recognised by the *CNC Shark*.

I found *VCarve* easy to understand and use, though a few hints may be helpful.

The initial screen encountered when opening a 'new' design asks for information about the size of the workpiece and the location of a zero point for the 'z' (vertical axis) and also for the centre of the coordinates for the geometry of the design. (Measurements may be set up in mm or inches.)

I found it easiest to locate the zero for the 'z' coordinate at the bottom left hand corner of the top of the blank I intended to use and to centre the 'x' and 'y' coordinates on the face of the blank, though other possible locations are offered.

Since the 'y' coordinate is vertical on the screen, this means that if type is entered for carving along the length of the blank, this will appear vertically (ie. on its side).

I found this annoying for about 30 seconds and while I still wonder why the software producer doesn't provide a radio button to switch the orientation by 90^0, it really isn't hard to get used to working with the blank upright.

The next screen is where the actual designing is performed.

For those familiar with the terms, this program works with vector files, not bitmaps. Bitmaps can, however, be imported from other programs and converted to vector format within *VCarve*.

Since my Report was being written for this magazine, it seemed logical to start with an *Australian Woodworker* logo. (The machine had arrived with a *Carba-Tec* logo cut in MDF – Photo.1.)

Two facilities are provided for the production of text directly in vector format. Unfortunately, neither gave me one of the typefaces I wanted, so I resorted to laying out the two words in CorelDraw, then opening the file in *VCarve* and converting it to vector format.

VCarve can open files created by a number of drawing/design packages such as AutoCAD and Adobe Illustrator. It can also accept PDF files which provides a path to extract text and vector content from other programs that can create PDFs, but may not be able to be opened directly in *Vcarve*.

You can also import image files (BMP, JPG, TIF, GIF and PNG) into a current job.

Working with Vectors

I later did some work with the built-in vector fonts in *VCarve* and was surprised to find that the program provides very good line spacing and kerning facilities. (Kerning is used to improve the appearance of type by permitting the distance between individual letters in a word to be increased or decreased.)

There are also facilities for making slight alterations in the shape of letters where their design may make it difficult for the router bit to follow.

The 'Creating Vectors' tools allow the creation of 2D designs on the screen. There are Circle, Oval, Rectangle, Polygon and Polyline options. Shapes can be created by either entering exact dimensions in the command window or by clicking the left mouse button in the 2D window to specify the parameters and coordinates dynamically by clicking/-dragging with the mouse cursor.

Once you have your design or several parts of a design — whether it's letters, straight lines, curves etc. — in vector format, *VCarve* gives you a large range of controls to manipulate it. You can join or break vectors, move or rotate them. You can cut, delete and align them relative to one another. You can copy and paste elements of the design and text can be fitted to curves.

Where desired, multiple copies of a design may be laid out to produce badges (Photo.11).

There are several other complex functions, the most important of these being 'nesting' and creating 'layers'.

'Nesting' permits the individual vector shapes in a complex design to be grouped together for further processing — a task that can be undertaken automatically (in some circumstances) or manually.

The assignment of parts of a design to specific layers is also designed to assist in the processing of complex projects.

Once you have finished with your design, *VCarve* provides a fresh set of tools that allow you to produce one or more toolpaths and calculate execution times.

You can view a 3D image of the finished project (Photo.7), even changing the colour of the wood to simulate the actual species you intend to use. While this facility is an essential part of ensuring that the intended result will be achieved, it also permits an image of the job to be printed for (or e-mailed to) a client.

Before calculating a toolpath, *VCarve* asks for selections that include the tool to be used, the overall maximum depth to be cut, the maximum depth to be cut in any single pass, the feed rate etc.

The tool on a *CNC Shark* is carried by a standard small Bosch router which has a 6mm chuck. While the first projects that most users will want to attempt will use a standard Vee bit, it's unlikely to be long before other bits are being employed.

A flat ended milling bit is, for example, ideal for the carving of fielded areas (pockets) with straight sides while dish cutting bits allow carving of the same areas with rounded corners between their horizontal and vertical surfaces.

As you would expect, separate toolpaths must be calculated for each tool used for a project.

3D Toolpaths

So far, discussion has been restricted to 2D toolpaths but some 3D operation is permitted by the machine. For example, '3D Texture Machining' uses a special-

ised toolpath algorithm and the shape of the tool to generate a textured finish on the part.

VCarve Output

The final *VCarve* screen, after all of the toolpaths have been calculated, lists the toolpaths and permits export of these in a file format accepted by the *CNC Shark*.

CNC Sharp Operation

The *CNC Shark* has two electronic boxes. One of these is connected to the computer by a standard USB cable. (Note that the computer must have a USB 2.0 port.)

The software for operation of the machine is downloaded from the website: *http://www.nextwaveautomation.com*. It includes the user interface and the machine drivers. (Carba-Tec has advised that it intends hosting these and all the other files available from the US manufacturers, on their Australian website.)

Opening the Basic Operation Panel on the computer gives the user access to the CNC machine.

The cutter must first be physically positioned to: x=0, y=0 and z=0. This is done using the variable rate 'jog' controls on the Basic Operation Panel.

After this, clicking on the G Code tab permits the project file to be opened.

Switching on the router (it is powered separately to the CNC machine) and dust extractor, then clicking on the start button (mysteriously marked 'Run from SD Card') begins the cutting/carving process.

Watching the *CNC Shark* for the first time is a fascinating experience. For reasons known only to the machine and program designers, the tool may start anywhere in the design, lifting up and moving over to another part, then back again.

Some of the work I did was in highly figured Camphor Laurel, a moderately hard but fairly clean cutting timber. The results were impressive and demonstrated that other than light sanding to remove furring at the edges of the cuts, little post machine work is likely to be required for most applications.

(The cutter used was the one that came with the machine and I've no idea how many jobs it may have done previously.)

Photo.6 shows a close-up of the result achieved with a woolly piece of Meranti. The small amount of chipping at the bottom of the cuts cannot be seen at normal viewing distance.

The Machine

While the machine is the central part of the process around which everything else revolves, its important features can be summed up by three words: Precision, Reliability and Speed.

The router and its cutting head are supported by solid shafts and moved by rotating screw shafts (Photo.3). It is a simple, but very rigid structure, the rigidity assisted by the incorporation of 12 precision line bearings (four on each axis.)

Regardless of the rigidity of the frame, however, there must inevitably be a slight amount of slack in the movement of the router when it reaches the end of its travel in one direction and has to reverse to move in the other.

To reduce this slack to the point where the manufacturer can claim a resolution of less than one thousandth of an inch is a remarkable achievement.

Despite the fact that letters are often cut in several separate passes of the tool, I found that variations in placement of the cutter are almost imperceptible in the final project. The tiny discontinuity on the right lower side of the Q in Photo.6 is at the join between two passes of the cutter and demonstrates the high resolution of the machine.

One word of caution though — the workpiece must be securely clamped in place before beginning to cut. The router moves quickly and the forces applied by its cutter are high, so even slight movement of the workpiece will ruin a project.

No mention has been made of cutting times since these vary widely depending on the complexity of the job but to give at least some indication, *The Australian Woodworker* logo shown in the photos took less than two minutes of machine time. Projects that include texturing (for example) will take much longer.

Going Further

I've encountered larger CNC machines before and been involved in some engineering projects which required their use. This is, however, the first time that I've been able to spend days working alone with one. Although small and relatively inexpensive (when compared with the majority of CNC machines used in industry) I found that it performed extremely well 'straight out of the box'. But it has so many other possibilities.

Even if a user comes to the point where it is felt most of these have been explored, alternatives to *VCarve* could bring new fields to conquer. The machine will interface with a raft of other CNC programs, among them: Photo Carve, 3D Cut, BobCad, BobART, BobNestCad, Mach 3 and Lazy Cam.

So Who will Buy it?

I can only envy the recreational woodworkers who have time to spend experimenting with this machine and its software. There are so many intriguing little challenges.

The method used for making flutes, for example, uses a 'ramp' function. This causes the cutter to move down and up along the prescribed toolpath. Could this be used in reverse to create outwardly curved surfaces? I don't know, but no doubt someone who buys a machine will be able to find out.

Hopefully, those who buy the *CNC Shark* for production work — whether they are professionals, recreational woodworkers or clubs — will also find time to experiment, but it is likely that the machine's main benefit to them will be huge savings in time and substantial decreases in costs.

Footnote: Readers who use CNC machines for woodworking are invited to contact The Australian Woodworker with a view to developing articles about their machines and projects - Ed.

Photo.10: When the design has been completed, the tool and the cutting parameters selected, the toolpath and estimated time can be calculated

Photo.11: Badge making is one of several special functions provided