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CNC Machine

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Abstract:

The CNC machine is controlled by manipulating cutting parameters that could directly influence the process performance. Many optimization methods has been applied to obtain the optimal cutting parameters for the desired performance function. Nonetheless, the industry still uses the traditional technique to obtain those values. Lack of knowledge on optimization techniques is the main reason for this issue to be prolonged.

Therefore, the simple yet easy to implement, Optimal Cutting Parameters Selection System is introduced to help the manufacturer to easily understand and determine the best optimal parameters for their turning operation. This new system consists of two stages which are modelling and optimization. In modelling of input-output and in-process parameters, the hybrid of Extreme Learning Machine and Particle Swarm Optimization is applied. This modelling technique tend to converge faster than other artificial intelligent technique and give accurate result.

For the optimization stage, again the Particle Swarm Optimization is used to get the optimal cutting parameters based on the performance function preferred by the manufacturer. Overall, the system can reduce the gap between academic world and the industry by introducing a simple yet easy to implement optimization technique. This novel optimization technique can give accurate result besides being the fastest technique.

Introduction

In Industry it is not efficient or profitable to make everyday products by hand. On a CNC machine it is possible to make hundreds or even thousands of the same items in a day [1-2]. First a design is drawn using design software, and then it is processed by the computer and manufactured using the CNC machine. This is a small CNC machine and can be used to machine woods, plastics and aluminum. In industry, CNC machines can be extremely large [3-5].

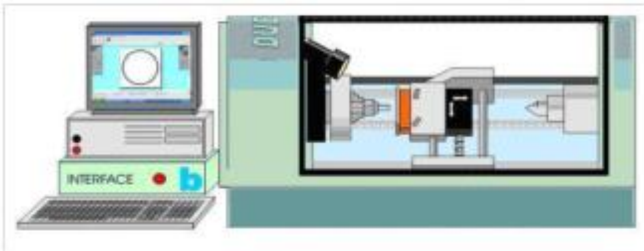

Fig.1.CNC machine model

MEANING OF 'CNC'

CNC means Computer Numerical Control. This means a **computer** converts the design into **numbers** which the computer uses to **control** the cutting and shaping of the material.

USE OF TYPICAL CNC MACHINE

1. The design is loaded into the computer which is attached to the CNC machine. The computer changes the design into a special code (numerical) that controls the way the CNC cuts and shapes the material [6].

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Fig.2.system

2. The material to be shaped is taped on to a block with double sided tape. This must be done carefully so that it does not come off the block during machining.

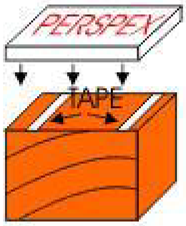

Fig.3. material

3. The block is then placed in the vice, inside the CNC. It must be tightened up carefully. If it is not secure when the machine starts to cut the material it can come away from the vice. When the machine starts working, the vice moves up, down, right and left according to the design.

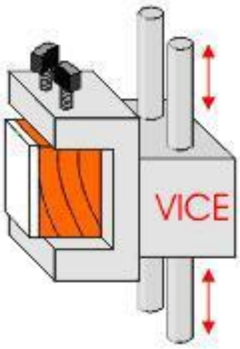

Fig.4. inside CNC

4. The guard is placed in position. It protects the machine operator in case the material is pulled out of the vice by the power of the cutter. For safety reasons, if the guard is not in position the motor will not start.

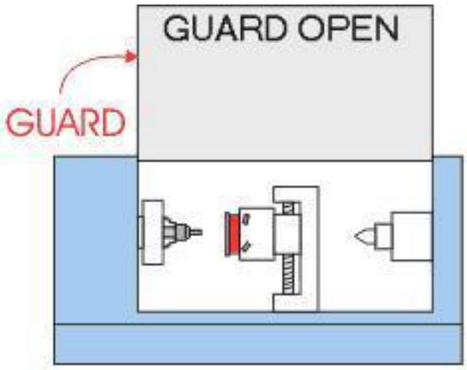

Fig.5. Guard Cutter

5. The CNC is turned on and the shape is cut from the material. When the cutter has stopped the shaped material can be removed from the vice [6-7].

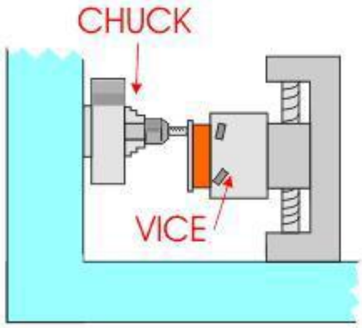

Fig.6. CNC inside cutter

PARTS OF CNC MACHINE

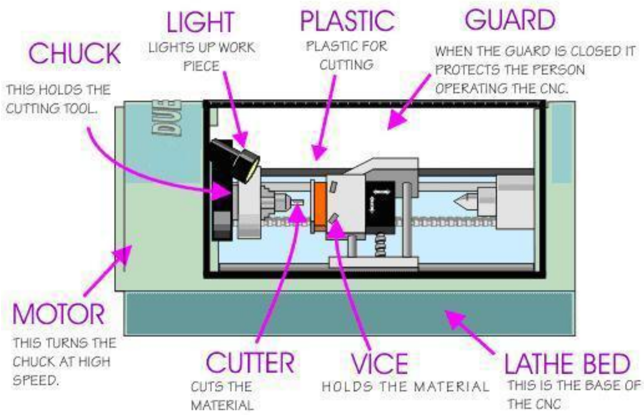

Fig.7. CNC machine parts

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VICE:
This holds the material to be cut or shaped. Material must be held securely otherwise it may 'fly' out of the vice when the CNC begins to machine. Normally the vice will be like a clamp that holds the material in the correct position.

GUARD:
The guard protects the person using the CNC. When the CNC is machining the material small pieces can be 'shoot' off the material at high speed. This could be dangerous if a piece hit the person operating the machine. The guard completely encloses the dangerous areas of the CNC.

CHUCK:
This holds the material that is to be shaped. The material must be placed in it very carefully so that when the CNC is working the material is not thrown out at high speed.

MOTOR:
The motor is enclosed inside the machine. This is the part that rotates the chuck at high speed.

LATHE BED:
The base of the machine. Usually a CNC is bolted down so that it cannot move through the vibration of the machine when it is working.

CUTTING TOOL: This is usually made from high quality steel and it is the part that actually cuts the material to be shaped.

CNC MACHINE - INPUT, PROCESS, OUTPUT
A CNC production facility needs three pieces of equipment:

A Computer:
The computer is used to draw the design. However, the design is only a picture and the CNC machine cannot use this to manufacture the product. The computer software must also convert the drawing into numbers (coordinates) that the CNC machine can use when it starts to cut and shape the material.

An Interface:
A computer cannot be directly connected to a CNC machine. The computer is connected to an interface. This converts the signals from the computer to a form that the CNC machine understands. The signals are in the form of digital signals when they are sent to the CNC machine [8-9].

CNC (Computer Numerical Control) Machine:
The signals from the interface control the motors on the CNC machine. The signals determine the way the vice moves. The vice moves in three directions X, Y and Z. (Horizontally, vertically and depth). The signals also control the speed of the cutting tool.

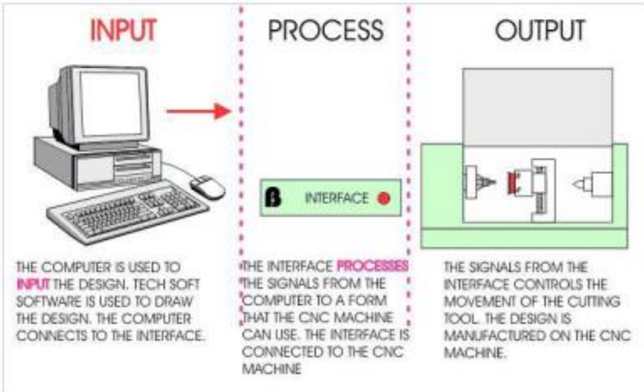

Fig.8.CNC operation steps

CONTROL PANEL OF CNC
A CNC machine is normally controlled by a computer and software. However, most CNC machines have a range of controls for manual use. It is rare for a CNC machine to be used manually as simple operations are best carried out on cheap/basic/manual machines. When a CNC machine is used manually it is been used well below its capability and specification.

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Fig.9. CNC range controller

RESET BUTTON:

The must important control button is usually the reset button. When the CNC machine is turned on, the reset button is pressed by the machine operator. This 'zeros' the cutter, moving the cutter to coordinates 0, 0, 0 on the X, And Z axis. In simple terms, the reset button moves the cutter to the corner of the machine, above the work table. If the reset button is not pressed, it is possible that the CNC machine will start cutting the material in the wrong place or even miss cutting the material and plunge into the work table [10-11].

MANUAL CONTROL:

The cutter can be controlled manually although this is rarely needed. The 'X' and 'Y' buttons control the movement of the cutter along the horizontal surfaces. The 'Z' buttons control depth and up / down movement.

STOP BUTTON:

Most control panels have stop buttons. When pressed these stop the machine very quickly.

SPEED AND FEED:

On some CNC machines it is possible to manually vary the speed and feed of the cutter.

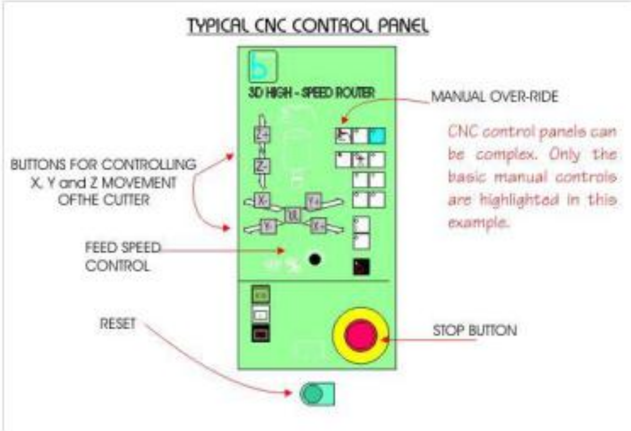

Fig.10. control panel

CNC ROUTER - THE IMPORTANT PARTS

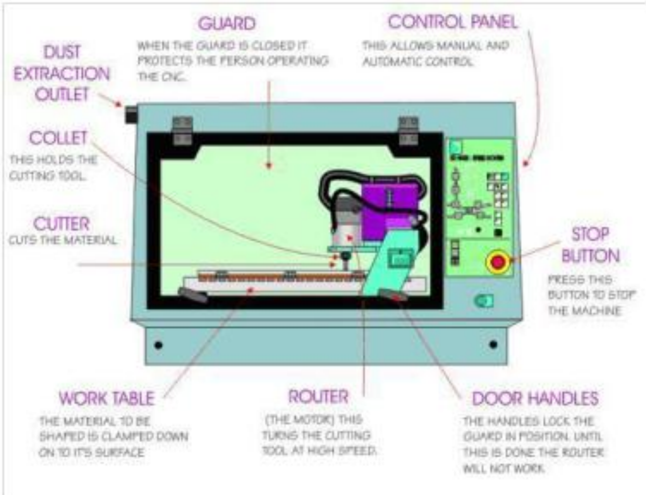

Fig.11. router parts

CNC MACHINES AND SAFETY

CNC machines are very safe to use as they are designed to be as safe as possible. One of the main advantages of CNC machines is that they are much safer than manually operated machines.

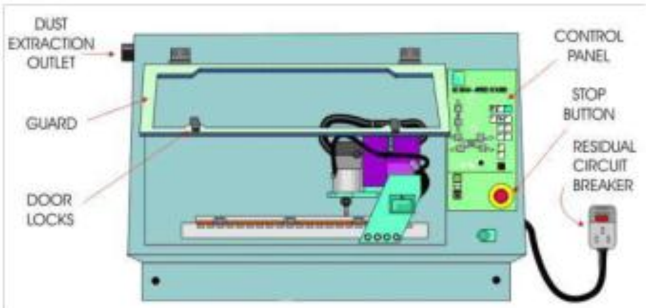

Fig.12. CNC machine with controller

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1. Most modern CNC machines are designed so that the cutting tool will not start unless the guard is in position. Also, the best CNC machines automatically lock the guard in position whilst the cutter is shaping material. The guard can only be opened if the cutter has stopped.

2. It is essential that pupils / students / machine operators receive 'quality' instruction before attempting to use any CNC equipment [12-13].

3. CNC routers, used for shaping materials such as woods and plastics, have built in extraction. Dust can be very dangerous if inhaled and can also cause eye irritation. The CNC Router shown above has an outlet for an extraction unit. As the router is fully enclosed, dust cannot escape into the atmosphere. If an extraction unit is attached the dust is removed automatically. Most manually operated machine routers have very limited extraction systems which leave some dust in the air.

4. The CNC router above has a single phase electrical supply. Older machines such as manually operated milling machines and centre lathes have three phase supplies. A single phase electrical supply can be 'plugged' into any available socket. The electrical supply for the machine comes through a residual circuit breaker (RCB). If an electrical fault develops the RCB will cut off electrical power immediately.

5. Single phase CNC machines can be moved more easily because they are simply unplugged and relocated. Three phase machines are specially wired by an electrician into the electrical supply and cannot be unplugged.

6. Most CNC machines work behind a guard or even a closed, transparent safety door. This means that the operated cannot be hurt by 'flying' pieces of sharp/hot material.

7. Common sense applies to the use of all machines including CNC machines. Basic safety training regarding working in a workshop and with other machines applies to CNC machines as well [.

SETTING UP THE CUTTING TOOL TO THE CORRECT LENGTH

One of the few operations that the machine operator carries out is to change the cutting tool. Each CNC machine has a range of cutting tools. Straight cutters chamfer V-groove and radius cutters are some examples. If a detailed design is being manufactured, it may be necessary to change the cutting tool at least once during the manufacturing process. It is very important that all the cutters are set up to exactly to the same length in the cullet. If this is not done the material being machined will be machined at incorrect depths. A special depth gauge is used to accurately set up the cutting tools. (See diagram below). This 'rule' applies to all CNC machines although different techniques may be used depending on the type of the CNC machine.

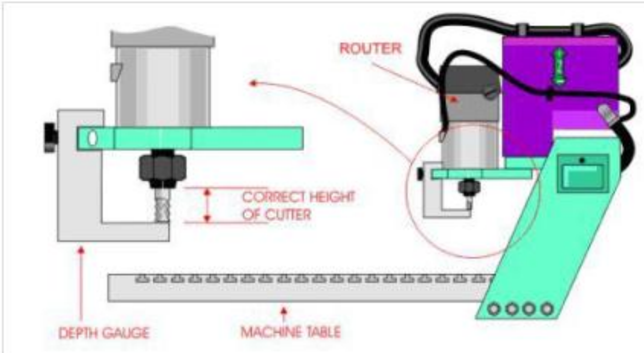

Fig.13. A special depth gauge is used to accurately set up the cutting tools

A pair of spanners is used to loosen the cullet and locking nut. The cutting tool can then be removed and the new tool put in position. Once the depth gauge has be used to check the distance from the end of the cutting tool to the cullet, the spanners are used again to tighten the cullet and locking nut.

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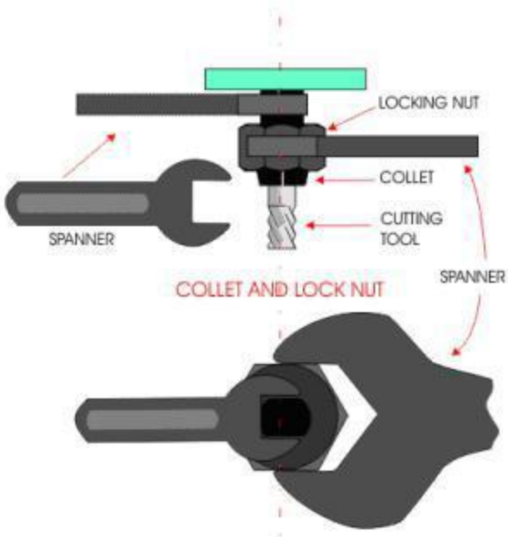

Fig.14. spanners

ADVANTAGES AND DISADVANTAGES OF CNC MACHINES

CNC (Computer Numerical Control machines) are widely used in manufacturing industry. Traditional machines such as vertical millers, centre lathes, shaping machines, routers etc. operated by a trained engineer have, in many cases, been replaced by computer control machines.

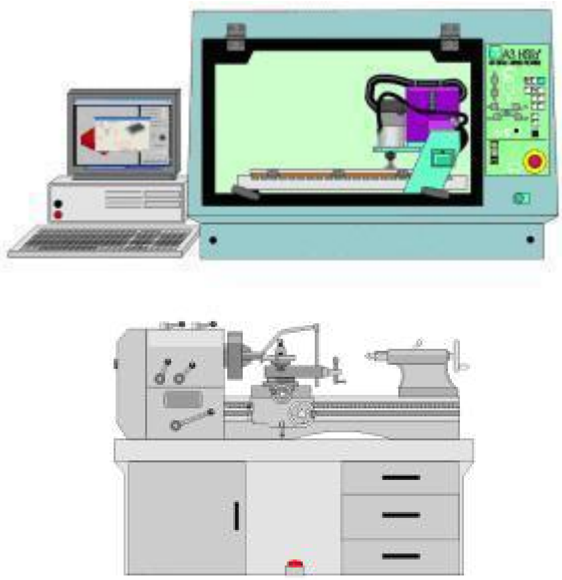

Fig.14. computer numerical control machine manually operated centre lathe

ADVANTAGES

1. CNC machines can be used continuously 24 hours a day, 365 days a year and only need to be switched off for occasional maintenance.
2. CNC machines are programmed with a design which can then be manufactured hundreds or even thousands of times. Each manufactured product will be exactly the same.
3. Less skilled/trained people can operate CNC's unlike manual lathes / milling machines etc... Which need skilled engineers?
4. CNC machines can be updated by improving the software used to drive the machines
5. Training in the use of CNC's is available through the use of 'virtual software'. This is software that allows the operator to practice using the CNC machine on the screen of a computer. The software is similar to a computer game.
6. CNC machines can be programmed by advanced design software such as Pro/DESKTOP®, enabling the manufacture of products that cannot be made by manual machines, even those used by skilled designers / engineers.
7. Modern design software allows the designer to simulate the manufacture of his/her idea. There is no need to make a prototype or a model. This saves time and money. 8. One person can supervise many CNC machines as once they are programmed they can usually be left to work by themselves. Sometimes only the cutting tools need replacing occasionally.
9. A skilled engineer can make the same component many times. However, if each component is carefully studied, each one will vary slightly. A CNC machine will manufacture each component as an exact match.

DISADVANTAGES

1. CNC machines are more expensive than manually operated machines, although costs are slowly coming down.
2. The CNC machine operator only needs basic training and skills, enough to supervise several machines. In years gone by, engineers needed years of training to operate centre lathes, milling machines and

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other manually operated machines. This means many of the old skills are been lost.

3.Less workers are required to operate CNC machines compared to manually operated machines. Investment in CNC machines can lead to unemployment.

4. Many countries no longer teach pupils / students how to use manually operated lathes / milling machines etc... Pupils / students no longer develop the detailed skills required by engineers of the past. These include mathematical and engineering skills.

2D COMPUTER AIDED DESIGN AND MANUFACTURE

There are two types of computer aided design software. 2D design software allows the designer to design shapes with very limited three dimensional properties. Do not underestimate the designs that can be achieved through 2D software.

1.The design is drawn using software such as Tec Soft 2D Design. At first appearance this software looks basic but, depending on the skill of the designer, quite complex designs can be produced. The example shown is a simple block of material with initials.

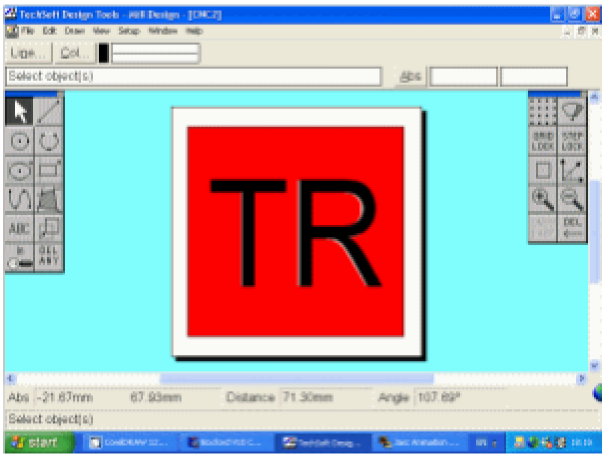

Fig.15.2D system design

2. When the design is complete the drawing is processed. This converts the drawing into a detailed series of X, Y and Z coordinates. Processing must take place before the CNC machine can cut the design from material. When the CNC machine shapes the material the cutter follows the coordinates, in sequence, until the shape has been manufactured.

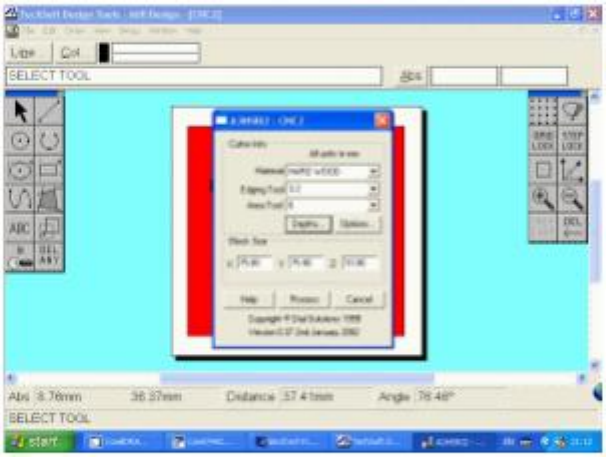

Fig.16.X,Y Coordinates details

3. Most CAD/CAM software allows the designer to test the manufacture of his/her design on a computer rather than actually making it. This saves time and materials. Testing designs is carried out using 'simulation' software. When the design is run through simulation software the computer displays the manufacturing on the screen. It also checks whether or not the design can be manufactured successfully. Many designs have to be altered before they can be made by a CNC machine.

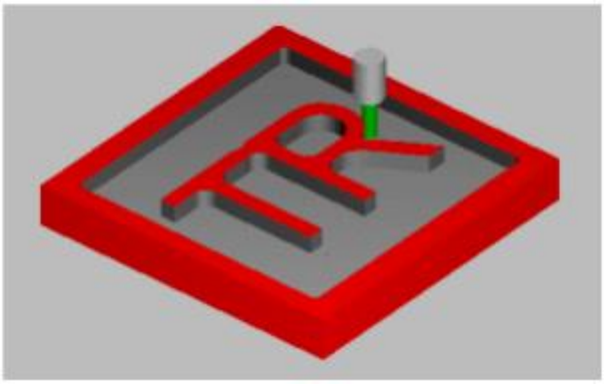

Fig.17. CAD design

4. After all the testing and improvements to the design, it can finally be manufactured on a CNC machine.

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Fig.18. finally out put

3D COMPUTER AIDED DESIGN AND MANUFACTURE

3D Design software allows the designer to produce three dimensional representations of his/her ideas. When completed the design can be viewed on the screen and it can even be revolved and examined at any angle. 3D software is much more complex than 2D software such as Tec Soft 2D design. It requires specialist training before it can be used competently.

1. The designer draws up the design using software. The design can be examined in detailed and if modifications/alterations are needed they can be made on the screen.

Software of this type allows the designer to model his/her idea on the screen rather than make/manufacture an expensive model. Good 3D software allows the designer to design almost any item.

Fig.19.designing process

2. The design is processed. When the design has been completed using software it must be exported as a stereo lithography file. This type of file can be imported into processing software which converts the drawing into a long list of coordinates. Each set of coordinates is called a G code & M code.

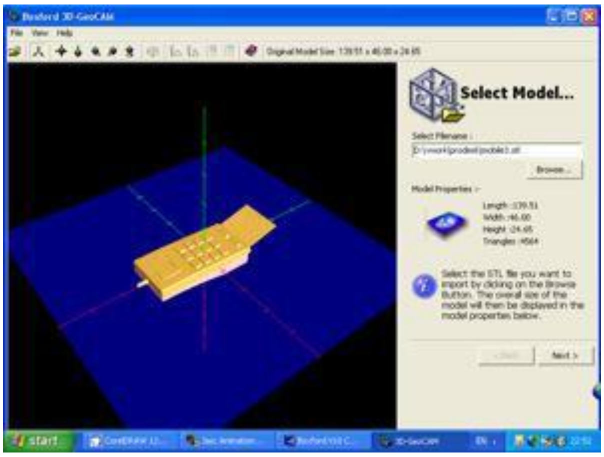

Fig.20. software design

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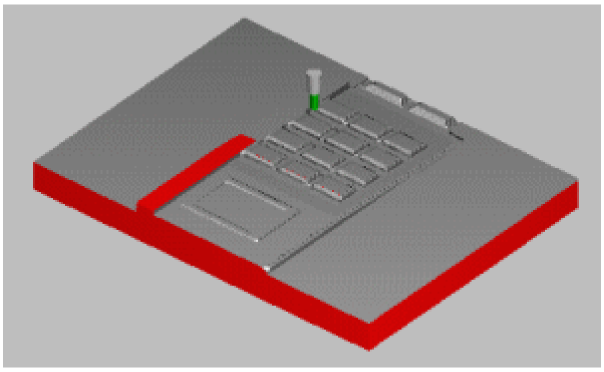

Fig.21. output design

4. An advanced CNC machine can be used to manufacture the three dimensional product. This CNC

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is both fast and accurate making suitable for school and industrial use.

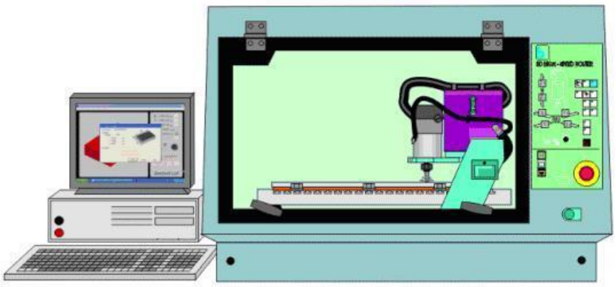
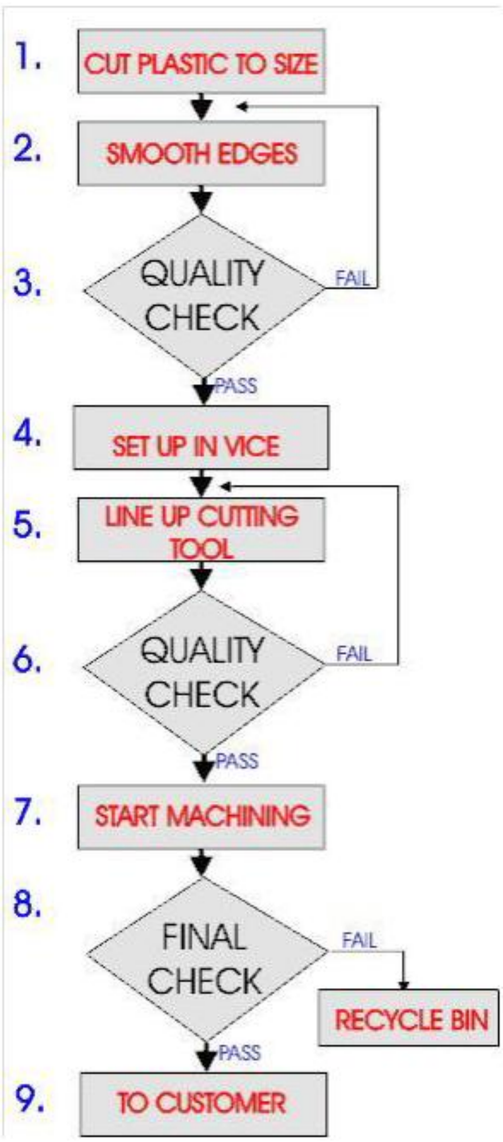


Fig.22.CNC machine

INDUSTRIAL PRODUCTION FLOWCHART



Results

Fig.23.CNC machine 1

Fig.24.CNC machine2

Fig.25.CNC machine 3

Conclusion

• Cnc mean computer numerical control machine it's a form of programmable automation drill drawings on wood use g coding consist of 3 motors and their drivers and pic with its basic circuit and body made of wood hold on motors and drill and the wood we want to draw on it

• We tried to make cheap fast safety cnc machine that drill on wood piece according to any drawing we draw to it.

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