Development of a Prototype of Desktop CNC Machine

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Abstract— CNC (computer numerically controlled) mills cut objects out of durable materials and are widely used in modern manufacturing. They enable rapid prototyping in workshops and improve the speed and efficiency of factory lines. Yet most mills are costly and difficult to use, keeping them out of reach for individuals and small businesses. It brings CNC technology to a size and price that will fit in your home or office. Its revolutionary simplicity makes it possible for everyone – whether a novice or trained engineer – to create high-quality finished products.CAD (Computer Aided Design) - Inscape, a vector drawing program specializing in SVG format graphics. Typically, a program such as Free CAD would be used to make a .dxf. CAM (Computer Aided Manufacturing) -Maker CAM, a Flash file which will import SVG graphics and allow one to define operations (such as Profile, Pocket, Follow Path or Drill) to be applied to, or along, or at the center of paths at feeds and speed rates appropriate to the selected material.

Key words: CNC, SVG graphics

I. INTRODUCTION

The desktop cnc milling machine is a 3-axis machine dependent upon the belts, pulleys, motors and electronics, doing everything possible to design an easy to assemble; it is able to move using stepper motors which are controlled by stepper drivers attached to a microcontroller. The typical tooling is an inexpensive rotary tool call spindle. Fully capable machine that will do its part in both the open hardware and desktop manufacturing movements.

- X-axis (side-to-side when facing the machine)
- Y-axis (towards or away when facing the machine)
- Z-axis (up or down)

II. OBJECTIVE OF RESEARCH

- Clear, easy to follow design
- Comprehensive construction and operation manual
- A "Desktop" size form factor with workspace
- Provide several project entry points: plans; kits; completed product
- Be built from either purchased or recycled (scavenged) materials and components
- Be budget-sensitive and cost-effective
- Operate with the majority of the commonly-available CNC apps
- Drive bipolar stepper motors (less expensive, more common, better torque)
- Buildable with minimal electronic or construction skills
- Configurable to accommodate a range of spindle options

III. PARTS OF DESKTOP CNC MACHINE

A. Pipes

B. Plexiglas

C. Rails (aluminium)

D. Stepper motor

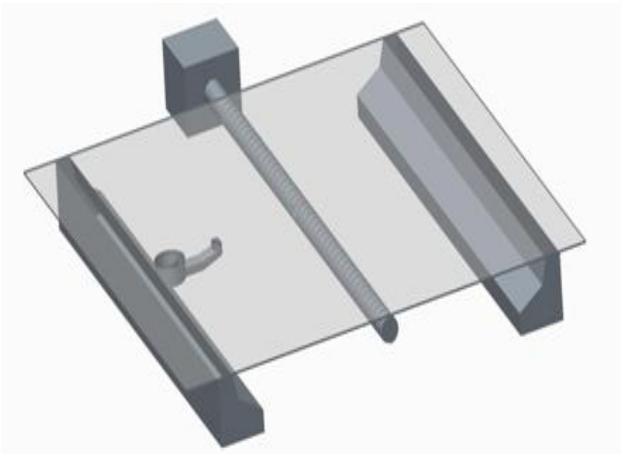
IV. WORK PLAN

A. Step 1: The Frame

The frame needs to be a flat base that we can mount everything on horizontally and a goose neck of some kind to hold the Z axis (the up and down part with the motor tool) firmly in place. Later, after you are sure all the pipe joints are in the right place .we can add a drop of thread sealer to the joints and it will be a good solid structure.

B. Step 2: The X Stage Rails and Motor

Next its time to add the rails for the X axis stage. These rails are U channel aluminum. Put a washer under each end to space the rail off the pipe just a bit. Now mount the stepper motor with a bracket like you see here. Connect threaded rod to the motor shaft with a short piece of rubber hose.
Take a piece of plastic (Plexiglas) ,something strong and flat and mount a piece of the U channel to it The round thing is a bearing. Mount it to a short piece of aluminum like so. Then take a coupling nut (a long nut) and wrap it with aluminum like so The bearing will hold the X stage to the X rail and the coupling nut will allow the motor to run the stage back and forth. It wouldn't hurt to grease the skids a little and the nut too.



C. Step 3: The Y stage

The Y stage is just like the X stage but turned 90 degrees. Mount two rails and a motor on the X Stage and then take another piece of flat material and a U channel and make the moving Y stage. Make the little bearing thing and a coupling nut for it too.

D. Step 4: The z stage

Take a flat piece, here I used a piece of white Plexiglas. Mount some rails and a Motor to it. Then make a moving stage piece with a u channel and a roller bearing. stage will hold the motor tool. Now since this stage is going to move up and down the weight of the motor tool will make it want to come off of the rails so we add a few more roller bearings to each side to keep it together.

Then its time to mount the stage to the frame. This is the mechanical structure. From here we will need to hook up the stepper motors to a controller and get some software running on the computer.

E. Mathematical calculation

- W=Weight of material:29N
- W=mg
- m=w/g=29/9.81=2.95kg
- Force(f)=mg=2.95*9.81=29 N
- Without frictional force total torque(τ=f*dm/2)
- Dm=mean diameter of lead screw
- Acme thread have 1 *1/4
- Dm= (major diameter + minor diameter)/2
- Dm=(1.25+1)/2=1.125 inch=28.57 mm

So, the total holding torque
τ= f*dm/2
28.9395*28.57/2=413.400 N mm=0.413 Nm
Total frictional force =0.413*1.15=0.47495 Nm
So the holing torque of stepper motor is 0.48 Nm

And by calculation we prove that our desktop cnc machine
Lift the 29 kg load for x-axis

- Tup={(F*Dm)/2}/{(L+$\pi\mu$Dm)/($\pi\mu$Dm-μL)}
  $\tan\lambda$=L/Dm
  L=$\tan\lambda$*dm=15.83mm
  Dm=28.57mm
  μ=0.15
  F=47.28N

All the values are putting into the equation we have a answer of =0.0023Nm for the z axis.

V. CONCLUSION

From the results obtained in the analysis of different literature survey, the following can be concluded. The research survey was implied to author to justified their research area in direction of developing a new model of desktop cnc machine and simplified method for analysis. The research survey was reflected different methodology such advanced modern control algorithms, advanced method of programming, web-based virtual operating. Some research paper indicated about feasibility of simultaneously controlling the position and orientation of the machine tool during the machining operation. The analysis performed in this research is based on some assumptions and restrictions. However, complete literature review and input parameter of method and configuration of desktop cnc machine. Therefore, the following are recommended for future work as extensions and elaborations of this research. In desktop cnc machine, they were done different method and design. Inexpensive machining and user friendly type hardware and software configurations. Reducing a size and reducing a complexity.These machines have played a real important

role in bringing about industrial revolution and have laid the foundations. But the bringing about of the new technology in the present era is very important. The conventional machines are required in small quantities whereas the desktop CNC machines must be increased to improve the quantity and quality of production.

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