Automated 3 axis Drilling with Routing System

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Abstract- *This thesis aims at describing the design of an automated 3 axis drilling machine. The said machine is designed with a view to keep the cost of the machine at minimum, hence making is suitable for use in small or medium scale industries. Along with the design of the mechanical components, the electronics and the software has also been designed. The said machine has also been fabricated and successfully tested. In this regard, this project work is taken up, which is aimed to design and develop one automated 3 axis drilling machine that can be used for drilling the ply. The program is prepared in 'C' language and a step by step approach is implemented to control four motors independently. Three DC motors are used to control the machine in three axes and one small DC motor of 4000 RPM is used for drilling purpose. Since it is a prototype module, the machine is designed to drill the ply. In drilling, the head will be moved to the referred position before each drilling. After the drilling is finished to the fed data, the drilling head will move back to the referred position. As per the data fed to the machine, it can drill as many holes as in specific area. After completing the task, the computer displays on its monitor that the job is completed.*

Keywords- Automated Drill, Motors, Sliders, Microcontroller, Screw Shaft.

I. INTRODUCTION

Current development in industry has been towards computer controlled manufacturing to increase quality and quantity of products. Manual manufacturing of such items as the circuit board will have a big faulty case and uneven quality. Then have developed an automatic print circuit board drilling machine, which is controlled by computer. The main aim of the project lies in interfacing or in simple words, is to make a mechanical system work, making use of a personal computer of basic configuration, this project is carried on keeping in mind the needs of a small scale industry, which need small sized components in a few number, which by other processes would cost them more. This project makes use of a printed circuit board that interfaces a drilling machine with a personal computer through a buffer. This system is mainly aimed at small scale production of printed circuit boards in small scale industries The system has an advantage of simplicity in operation, moreover the cost of production comes down for a small scale sector. Though the system involves

many small electronic parts it is easy to study the working, and in operation, as use the simple user-friendly language in programming the software.

II. BASIC DESIGN CONCEPT

The goal here is to design and build a very low-cost, very simple, desktop drilling machine, which is used for drilling the ply. Drilling the Ply's manually consumes lot of time and due to errors by drilling at wrong points, causes wasting many plys. All these problems can be avoided by implementing CNC concept, there by this project work is taken up and a prototype module is constructed for the live demonstration. Since it is a prototype module, size of the work or drilling size of the ply is minimized. Due to the restriction, the machine cannot drill ply of more than 22x25cm.The platform which moves in X, Y directions is made out of wooden ply of 5 mm thick is used, A thermo coal sheet of same size can be arranged over the plat form and the job (the Ply which is supposed to be drilled) can be kept over the thermo coal with some fixing arrangement. The mechanical transmission section to drive the X, Y table is designed with Sliding channels, the whole mechanism of X, Y table is designed with two dc motors, two screw rods of 43cm and 36cm respectively. When the motor rotates, screw rod also rotates and moves the sliders, which is loaded with nut. Depending up on the motor speed, slider travels along with screw rod at certain speed. And depending up on the motor shaft rotation direction (clockwise or anti clockwise) nut along with slider moves in both the directions, i.e., forward or reverse. Likewise with the help of two dc motors, the X, Y table moves in X, Y directions. Another screw rod with slider is used and it is arranged in vertical direction for drill machine, which moves in 'Z' direction. In general the mechanical construction slightly differs with this machine, the detailed description is as follows. A computer-controlled drilling machine requires a device that guarantees that the drilllands repeatable at the specified point. This device should be firmly fixed to the machine and in any case designed to make precise alignment easy.

III. INTRODUCTION TO CONCEPT

The system uses three pivots, two for moving the X, Y table for positioning the job at specified coordinate and one for the drilling mechanism. This allows any desired point on

the circuit board to be brought into range on the turntable. This system has the big advantage over a linear construction. This requires no expensive specialist components: the screw shaft simply have to remain vertical and free of play.

IV. METHODOLOGY

Our project comprises of three subsystem i.e. mechanical, electrical and software. All the parts of mechanical and electrical subsystem are described above. Our microcontroller consist of two programs i.e. case1 and case2. Case1 instructs the mechanical subsystem of our model to perform single drill, whereas case 2 instructs to perform two drill (one behind other). There are two control switches in our system. Switch 1 is used to select a particular case and the other switch is used to start the selected case (mechanical subsystem starts). In mechanical subsystem, the motor with 200rpm is connected with a screw shaft which provide x axis motion to two side support member, on the top of which another motor with a screw shaft and a slider on the shaft is mounted which can move in y axis. Now by using L clip another motor with a small screw shaft is mounted on slider and on this small screw shaft another slider is mounted with drill motor which provide the z axis motion to drill. Our complete model is shown in Fig -1.

Table -1: Machine Specifications

Machine Specifications		
1	Table Dimension	39.5 cm X 30 cm X 40 cm
2	Travel Dimensions	22 cm X 25 cm
3	Structural Material	Wood
4	Motor Type	DC motors

For the control of the machine we used microcontroller.

In our project we have used ATmegha32-8bit microcontroller and the implementation of this chip is on the popular Arduino development platform.

The basic working of our model is described below:

The first step is to plug in the adaptor and switch it on.

Now the whole electrical system along with the display starts.

The display will give the choice of two cases from which only one case can be selected as per our requirement by pressing control switch 1.

Now by pressing switch 2 our selected program starts.

As our program will starts now the whole mechanical system comes into motion.

Now the motor with 200 rpm will make the slider having two side support member to move in x axis with an appropriate distance.

With this x axis motion the slider having y axis motion moves in respective distance and due to this the drill bit comes in the line of axis of the defined points.

After this the z axis slider moves and due to which drill bit moves in the defined path and performs the drilling operation.
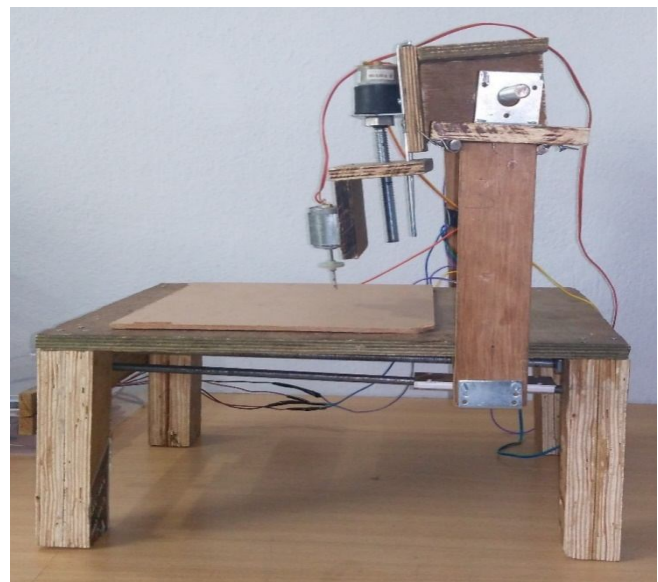

Fig -1: Automated Drilling with Routing System

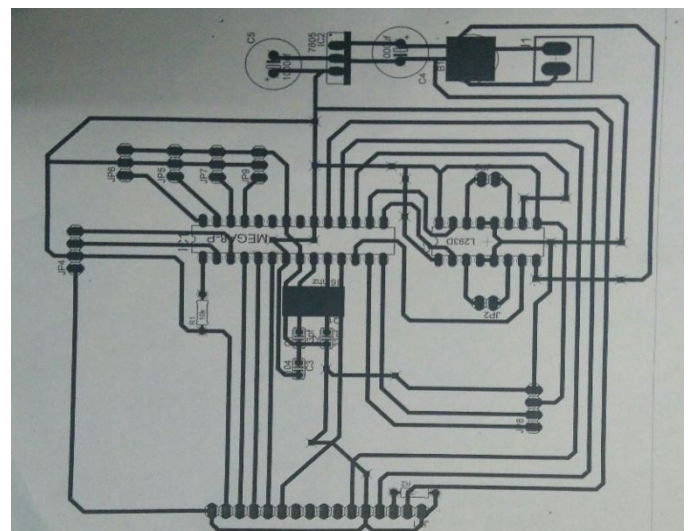The complete circuit diagram of the project work is given below:

Fig -2: PCB Design

V. CONCLUSION

This project revealed that building a relatively low cost automated 3 axis drilling machine is possible. Also the benefits having such a tool saves both time and money. In the future more process level outputs, constraints, cost estimation, and a CNC program editor with syntax check will be added into the current one and finally the results will be benchmarked with industrial tests.

With the increasing demand for small scale high precision parts in various industries, the market for small scale machine tools has grown substantially. Using small machine tools to fabricate small scale parts can provide both flexibility and efficiency in manufacturing approaches and reduce capital cost, which is beneficial for small business owners. In this thesis, a small scale three axis drilling machine is designed and analyzed under very limited budget.

The automated 3 axis drilling is tested with different tests to determine its accuracy. We found that the required drill is proper and accurate and ply with thickness of 5mm can be easily drilled by using a drill bit of 0.8mm diameter.

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