# Arduino Controlled Milling and Drilling Machine

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*Abstract*— Our main aim of the project "Arduino controlled milling and drilling machine" is to support mass production in small scale industries. Our project reduces manpower, increases accuracy, reduces time consumption of machining. The Arduino acts as the control system for the machine. It has the ability to machine through the instructions from android phone with the use of ArduinoDroid or Arduino IDE app.

***Key words:*** Small Scale Industries, Mass Production, Arduino Control, Machining

## I. INTRODUCTION

Due to the rapid growth of technology the usage & utilization of CNC machine in industries are increased. The fabrication of low cost CNC machine that is the Arduino controlled machine is used to reduce cost and complexity of machine. This project deals with the design of automatic mini CNC machine for milling, drilling and boring. The lower cost is achieved by incorporating features of PC with ATMEGA 328 controller in an Arduino

## II. EXISTING SYSTEM

The mass production in large scale industries in done by CNC machines. There would be a separate microprocessors in CNC machines as control system. It requires very less manpower. Meanwhile, the small scale industries use only manually operated machines like lathe, vertical milling machine, upright drilling machine for mass production because they don't afford CNC machines which minimum price is seven lakhs for a normal CNC plotting machine. The small scale industries more man power , lacks in accuracy and time consumption is higher.

## II. PROPOSED MODEL

From the base paper study ,we learnt about the two axis plotting machine where the instructions are given through the Arduino .With that development of that base paper ,we are doing our project as machining project with the inclusion of the third axis .The first axis for the horizontal movement of the workpiece on which the machining process has to be done.

The second axis is the vertical movement of the tool piece for machining and the third axis is the depth for the drilling and machining process.

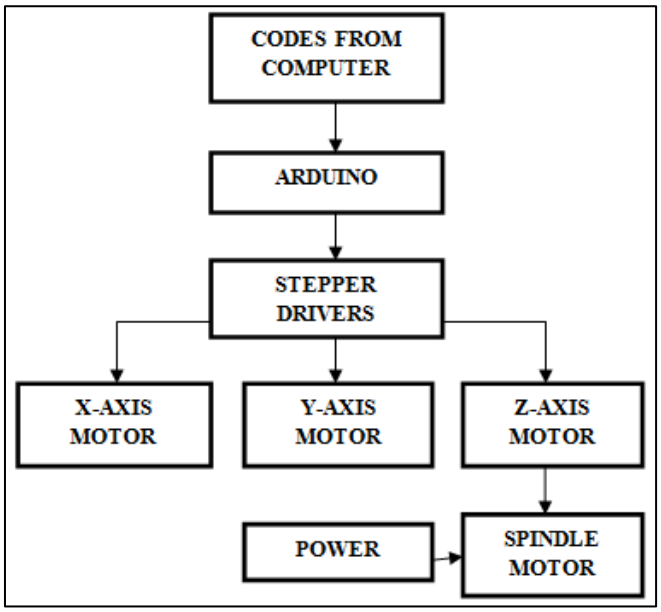


Fig. 1: Proposed flowchart

The codes are uploaded to the arduino by connecting with PC through the arduino application. The Arduino is connected to the 5V power supply battery which sends the signal to the stepper drivers. There are three stepper drivers for the three stepper motors .The stepper motors are used for the positioning of the axes for machining. In the third axis the spindle motor that is the DC motor is installed .At the end of the spindle motor, the spindle, the drill bit or the milling tool is connected.

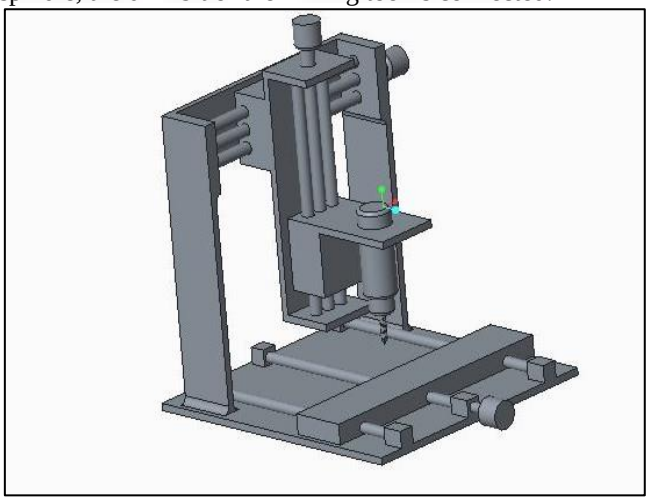

Fig. 2 : CAD model Isometric view

## III. DESIGN CALCULATION

### *A. Dimensions*

X axis
Lead screw length = 500 mm
Width of the axis = 500 mm
Pitch of the lead screw = 2 mm
Radius of the lead screw=12mm

 

Y axis
Lead scew length =500mm
Width of the axis =100mm
Pitch of the lead screw =2mm
Radius of the lead screw=2mm
Z axis
Lead scew lenth =250mm
Width of the axi s =100mm
Pitch of the lead screw =2mm
Radius of the lead screw =12mm

*B. Load calculation*

Z axis
Servo Motor =1.5 Kg
Drill tool =109 g
Shaft Coupler =0.6 Kg
Lead Screw With Slider Axis=1.2 Kg
Total =3.4Kg
Y axis
Z Axis Components =1.3 kg
Lead Screw With Slider axis =1.2kg
Z Axis Stepper motor =250g
Total =4.85Kg

*C. Power calculation*

Co-efficient of friction, μ=0.0015
Tanα = p/(πd)
= 1/(πx10)
= 0.0318
tanφ=μ = 0.0015
Mass on lead screw in Y-direction, m= 5 kg
External force, Fe = m x g
=5 x 9.81
=49.05 N
Frictional force, Ff = μ x m x 9.81
(selectingμ=0.0015)
= 0.0015 x 5 x 9.81
= 0.0736 N
Total force Ft = Fe + Ff
Ft = 49.05 + 0.0736
=49.1236 N
Tangential force required at the circumference of screw is,
F = Ft × [tanαtanφ]/[1-tanα× tanφ]
=49.1236 x [0.0318+ 0.0015] / [1-0.0318x0.0015]
= 1.636 N
On the basis of tangential force torque required for screw rotation is,
T = F× d/2 + μ× Ft × R
= =1.636 x 10/2 + 0.0015 x 49.1236 x (10/2)
= 8.5484 N-mm
= 0.0854 Kgf-cm
Speed of lead screw, N
N = 30 rpm.
Angular speed, WY = 2πN/60
= 3.14 rad/sec
Power, PY = TY × WY
= 0.0854 x 3.14
= 0.2681 W

*D. Bearing selection*

Outer diameter = 30 mm
Bore = 08 mm
Thickness = 9 mm

Stepper motor selection
Type - Stepper motor
Holding torque - 18 Kg.cm
Current - 3 Ampere
Voltage - 12 Volt
Torque - 2kgf.cm

## IV. STRUCTURAL ANALYSIS

Structural analysis is carried out by ANSYS to find out the stress distribution and total deformation on each axis.

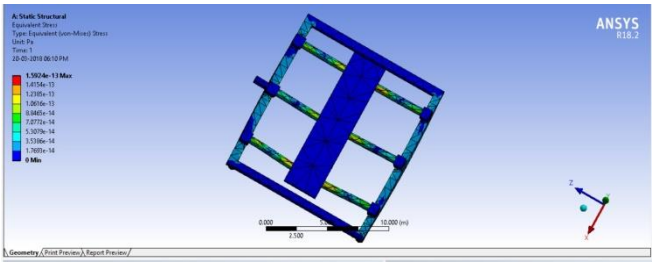

Fig. 3: Von mises stress analysis of X axis

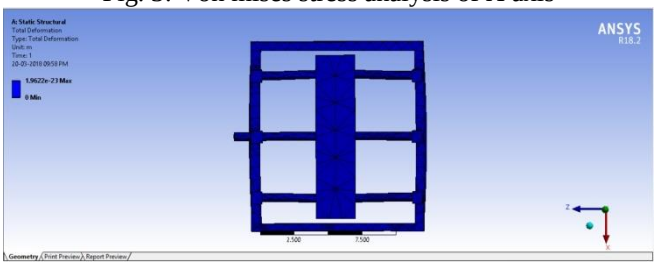

Fig. 4: Total deformation analysis of X axis

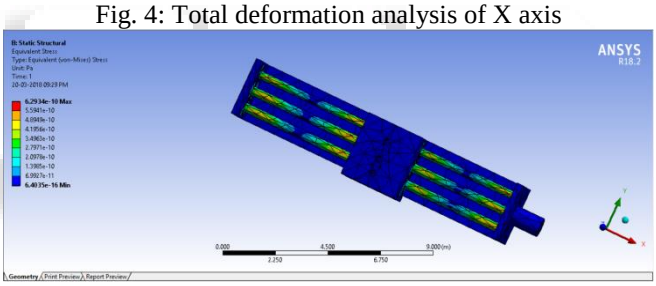

Fig. 5: Von mises stress analysis of Y axis

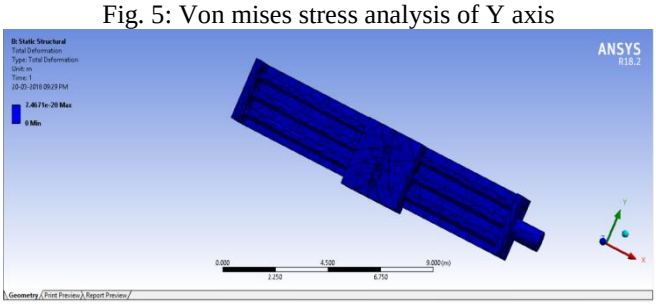

Fig. 6: Total deformation analysis of Y axis

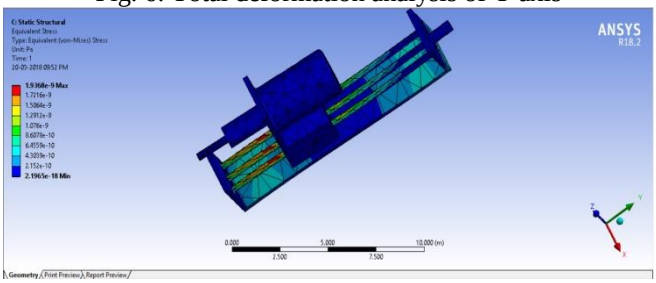

Fig. 7: Von mises stress analysis of Z axis

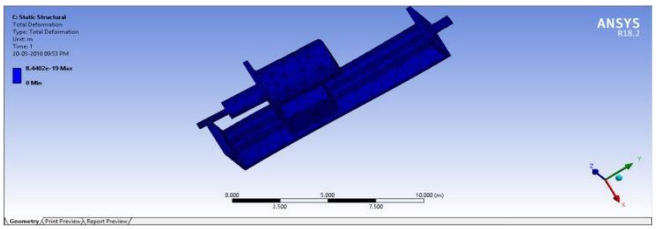


Fig. 8: Total deformation analysis of Z axis

## V. EXPERIMENTAL MODEL

Fig. 9: Fabricated model

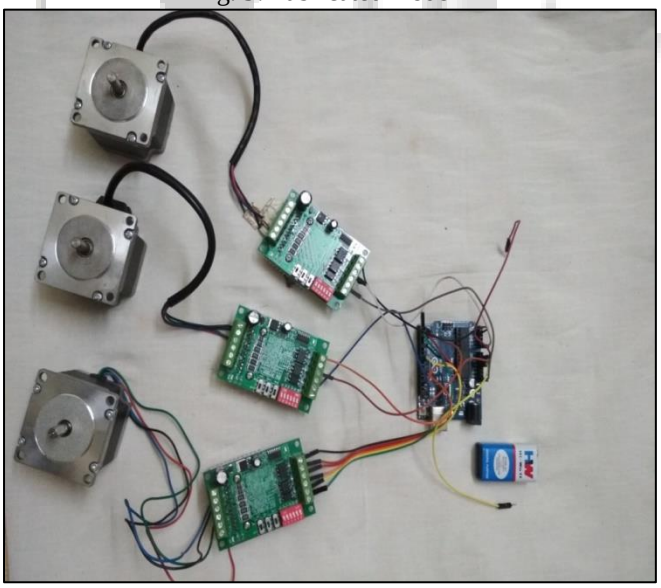

Fig. 10: Circuit connection from arduino to Stepper motor

## VI. CONCLUSION

In its development, the cost incurred is very competitive and relatively cheap compared with the milling and drilling machines available on the market. Several tests must be conducted to adjust the appropriate parameters such as time delay or motor rotation speed for the optimal work. In our future works, we will continue to enhance different aspect of the machine in order to have its function of milling and drilling in a more economical and efficient manner.In this project, the proposed Arduino based NC machining is equipped with three dimensional movements and considered to produce good precision accuracy for a competitive development cost comparing with another machine products manufactured by other companies which are not accurate, especially in milling and with high cost material that is used in design. We have made it much more easier by the connection of arduino with android phone and accessing from it.

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