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AERONAUTICAL AND MECHANICAL ENGINEERING**Review on Development of CNC drilling machine for producing incline holes****Mr. Dhiraj D. Dube<sup>1</sup>, Prof. M.S.Tufail<sup>2</sup>, Mr. Chetan P.Sable<sup>3</sup>**<sup>1</sup>*M.Tech CAD/CAM, Y.C.C.E., Nagpur, Mail: [dhirajdube@gmail.com](mailto:dhirajdube@gmail.com)*<sup>2</sup>*Asst. Prof., Y.C.C.E., Nagpur*<sup>3</sup>*M.Tech CAD/CAM, Y.C.C.E., Nagpur, Mail: [chetanpsable@gmail.com](mailto:chetanpsable@gmail.com)*

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**Abstract**

Creating small angular holes is the requirement of many industries. Holes of different size and large no. must be created with high precision. Therefore it is decided to design and develop a drilling machine to produce holes at required angles. A thorough study on considering different parameters is carried out. A review is presented here.

**Keywords:** CNC; drilling machine; holes; micromachining; Microcontroller.

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**1. INTRODUCTION**

Now a days application of micromachining are continuously growing. These operations are required to fabricate the products in medical science, automobile industries, in electronics systems etc. Micro drilling is not only deals in drilling holes in small parts but sometimes small holes may be required for large parts. Small and highly accurate holes are widely required in industries.

**2) Classification of drilling machines:****2.1) Table top small drilling machine:**

- i. It is small drilling machine of height upto 3 ft.
- ii. Mounted on table and supported with bolts.
- iii. Low speed and feed rate and thus used for less production rates.
- iv. Used for producing small diameter holes upto 10 mm.
- v. Low power requirements.

**2.2) Pillar drilling machine:**

- i. Diameter of holes upto 3-20mm.
- ii. Has long column on which table is mounted.
- iii. Table can be moved up and down for accommodating large size workpieces.
- iv. Since table size is small, therefore only used for lighter workpieces.
- v. Power requirement is 1.1 KW max.

**2.3) Column type drilling machine:**

- i. Strong powerful and rigid construction.
- ii. Different drill speeds can be achieved.
- iii. Can be used for producing variety of holes.
- iv. Quick change of speed and feed rate can be possible.
- v. Spindle is always vertical.

**2.4) Radial drilling machine:**

- i. This machine also has vertical tubular column like pillar drilling machine, but the tube here is very rigid.
- ii. Drilling head may be vertical, tilting or swiveling to produce inclined holes.
- iii. Manually operated.
- iv. The work piece is mounted on radial arm and this arm can move inward and outward.
  - a. Very large work volume.
  - b. Mainly used for batch production.
- v. Jobs with odd shapes can be performed.

**2.5) Hand drilling machine:**

- i. It is a portable drilling machine.
- ii. The drill is held in hand.

**2.6) Gang drilling machine:**

- i. It uses more than two drill heads.
- ii. Can produce no. of holes simultaneously.
- iii. Used for large jobs.
- iv. Suitable for batch production.

**2.7) Turret type drilling machine:**

- i. No. of drills can be used.
- ii. Drills are mounted on a turret head.
- iii. Table can be moved in X and Y direction.

**3) Application of drilling machine for producing inclined holes:**

Most of the times it is required to produce inclined holes in the workpiece. By using available drilling machines, especially radial drilling machine, it becomes quite easier. There are two possibilities to drill the hole at an angle, first is to tilt the table and the second one is to rotate the spindle through required angle.

The first case, that is tilting the entire worktable can only be considered for large workpiece, but if we are focusing on small workpiece (Having diameter upto 1 mm) to produce inclined holes, then this option becomes tedious.

Therefore best available option is to turn the spindle to get the inclined hole. But tilting the spindle requires taking in consideration different machining parameters like speed, feed and depth of cut.

**4) Different parameters and their effects on hole quality:**

The cutting parameters for micro drill of upto 1 mm are, speed= 2000-3000rpm, and feed rate upto 5-10 mm/min.

- 1) Surface roughness is mostly affected by spindle speed and feed rates. If the value of spindle speed and feed rate increase, surface roughness will also increase
- 2) Material removal rate (MRR) decreases when spindle speed, feed and tool diameter decrease.
- 3) Increased Spindle speed, feed rate and tool diameter increases the quality of hole.

### 5) Design idea of CNC drilling machine:

- 1) While designing a CNC drilling machine, there are three axes namely X, Y and Z which we have to control.
- 2) X and Y axes controls the motion of worktable.
- 3) Z axis controls the motion of drill upward or downward.
- 4) For producing inclined holes, the Z axis must be turned through required angles.

### 6) Selection of components for CNC drilling machine:

#### 6.1) Stepper motors:

- i. Stepper motors for controlling the motions in X and Y direction and tilting the drill head through the specified angle.
- ii. Stepper motors transforms the applied voltage into pulses to control the motion of parts.
- iii. It allows precise control of speeds and position generally without the necessity of feedback.

#### 6.2) Power drive:

- i. It is a power electronic circuit to supply switching current to the motor windings.

#### 6.3) Electro mechanical positioning of linear axes:

- i. Axes convert rotational motion of motor into linear translation motion.
- ii. This facilitates the movement of table in XY direction and movement of tool (here drill - bit) in upward and downward direction.
- iii. The axes use internal spindles and ball bearings, and transfers internal linear motion to an outside slide which moves along a rigid guide.
- iv. The axes can be placed at any direction and can be operate in a sliding mode.

### 7) CONTROL CIRCUIT:

#### 7.1) Controller:

- i. PLC or microcontrollers are required to control the functions.
- ii. Normally microcontrollers are preferred because they are cheap and satisfy control requirements.

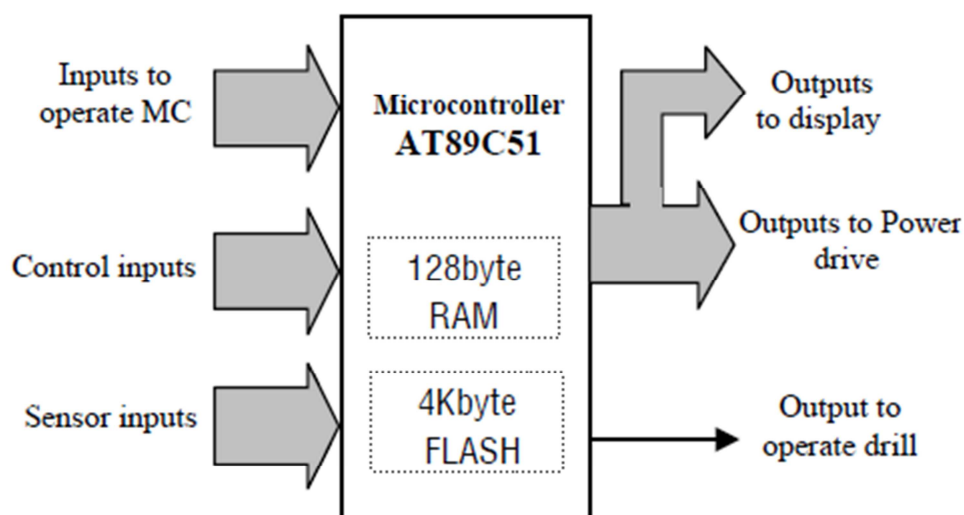


Fig. 7.1 Microcontroller

Above figure shows the microcontroller and five signal groups.

- a) Inputs to operate the microcontrollers.
- b) Control inputs.
- c) Inputs from sensors or position of X,Y and Z axis.

- d) Outputs to power drives.
- e) Outputs to drill

#### 7.2) Drilling motor:

- i. It is very important part of the whole system.
- ii. It must satisfy requirements like: high power, high starting torque, more revolving speed.

#### 7.3) Display:

- i. Display for X, Y position control is essential for monitoring the system.

#### 7.4) CNC system:

- i. The hole data is converted into the data appropriate for microcontrollers.
- ii. This data is loaded into flash ROM of microcontroller.

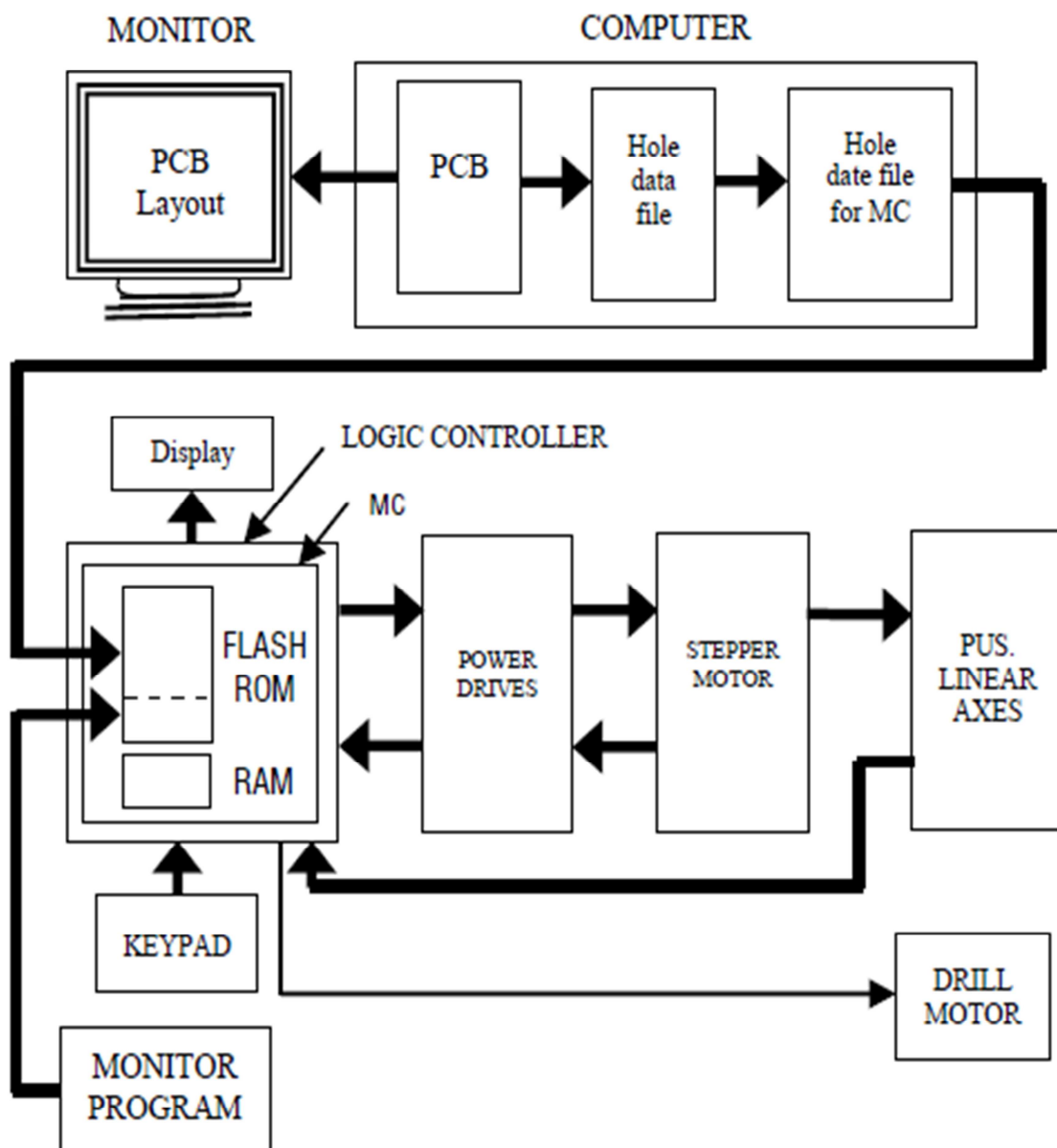


Fig. 7.4 CNC System

## 8) CONCLUSION:

The above mentioned are the some basic reviews of the CNC drilling machine. To develop a rigid and robust drilling machine following are the some concluded points must be taken into considerations:

- 1) The base structure and XY table must be designed by considering the weights appropriately.
- 2) Motors must be selected as per requirements. Sometimes servomotors are feasible for small components having low weight.
- 3) Coupling must be provided between motor axis and load. Flexible coupling is normally recommended.
- 4) Cutting parameters are to be optimized for producing holes with require quality. Popular optimization technique is of Taguchi method.

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