



NC Drilling Machine (Numerical Control Drill Machine) with Ultrasonic Sensor.

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Abstract:

Drilling machine can be defined as an instrument which is used to drill holes. Drilling machine plays an important role in mechanical workshops. The purpose of this project work is to get hold of complete information pertaining to drilling machines. A drilling machine comes in many shapes and sizes, from small hand-held power drills to bench mounted and finally floor-mounted models. Today the Industrial growth is purely depends up on latest machines; therefore the subject of drilling machines is extended too widely, because today wide varieties of drilling machines are designed for various applications. The most advanced version-drilling machine is CNC (Computer Numeric Control), it is used for drilling the PCB" s (Printed circuit boards). CNC Drilling is commonly implemented for mass production.

INTRODUCTION

Drilling machine can be defined as an instrument which is used to drill holes. Drilling machine plays an important role in mechanical workshops. The purpose of this project work is to get hold of complete information pertaining to drilling machines. A drilling machine comes in many shapes and sizes, from small hand-held power drills to bench mounted and finally floor-mounted models. Today the Industrial growth is purely depends up on latest machines; therefore the subject of drilling machines is extended too widely, because today wide varieties of drilling machines are designed for various applications. The most advanced version-drilling machine is CNC (Computer Numeric Control), it is used for drilling the PCB" s (Printed circuit boards). CNC Drilling is commonly implemented for mass production.

Simple drilling machines like hand held portable drilling machines, power feed drilling machines, etc. are quite common, we can find these machines everywhere. Often these

machines are used for drilling a through hole over the job; these machines cannot be used for number of machining operations for specific applications. Human force is required to drill the hole, drilling depth cannot be estimated properly, job may spoil due to human errors, and different size holes cannot be drilled without changing the drill bit. Consumes lot of time for doing repeated multiple jobs, these all are the drawbacks. To overcome all these problems, this automated drilling machine is designed which is aimed to drill the holes automatically over a job according to the drilling depth data programmed through a key board. The main concept of this machine is to drill the holes over particular jobs repeatedly at different depths, sequence is maintained. As the machine contains drill motor, the movement is controlled accurately.

The mechanical transmission section is controlled with stepper motor, based on the drilling depth programmed through h

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keyboard; the microcontroller restricts the movements of drill motor through stepper motor. Entire process falls under the subject of Mechatronics, & various fields of technologies must be included to full-fill the target. The integration of electronic engineering, mechanical engineering, electrical engineering, & control technology is forming a crucial part in this design. Especially the control circuit designed with microcontroller plays dominant role in this project work.

The method of converting rotary to linear motion is implemented in the mechanism. The control circuit is designed with 89S51 microcontroller which operates a stepper motor according to the program written in the microcontroller. The program is written in such a way, so that the Micro controller can read and it can store the information received from the keyboard.

The most important electrical device used in the project work is Stepper motor. Today stepper motors are widely used for many applications: particularly in the field of mechatronics & robots these motors are playing a major role. The stepper Motor used in this project work indigenous one. The stepper motor is an easy and reliable device to convert electrical energy into mechanical motion. Since each input change causes exactly one step rotation, a stepper motor may be operated in an open loop system.

1.2 Objective of Project

The objectives of this project is,

- To reduce drill bit losses.
- To avoid dislocation.
- To improve drill accuracy.
- To improve productivity.
- Desired depth of the hole can be obtained.

LITERATURE SURVEY

A.S.Udgave, Prof.V.J.Khot, "Design & development of multi spindle drilling head (msdh)", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).

The growth of Indian manufacturing sector depends largely on its productivity & quality. Productivity depends upon many factors, one of the major factors being manufacturing efficiency with which the operation /activities are carried out in the organization. Productivity can be improved by reducing the total machining time, combining the operations etc. In case of mass production where variety of jobs is less and quantity to be produced is huge, it is very essential to produce the job at a faster rate. This is not possible if we carry out the production by using general purpose machines. The best way to improve the production rate (productivity) alongwith quality is by use of special purpose machine. Usefulness and performance of the existing radial drilling machine will be increased by designing and development of multispindle drilling head attachment. This paper deals with such development undertaken for similar job under consideration along with industrial case study. [1]

B. Malleswara Swami, K.SunilRatna Kumar, "DESIGN AND STRUCTURAL ANALYSIS OF CNC VERTICAL MILLING MACHINE BED", IJAET/Vol.III/ Issue IV/Oct.-Dec., 2012/97-100.

In this paper, a machine bed (Manufacturer: M/s Lokesh Machine Tools Ltd) is selected for the complete analysis for both static and dynamic loads. Then investigation is carried out to reduce the weight of the machine bed without deteriorating its structural rigidity and the accuracy of the machine tool by adding ribs at the suitable locations. In this work, the 3D CAD model for the base line and the optimized

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design has been created by using commercial 3D modeling software CATIA. The 3D FE model has been generated using HYPERMESH. The analyses were carried out using ANSYS and Design Optimization is done with the help of Optistruct. The results were shown with the help of graphs to analyze the effect of weight reduction on the structural integrity of the machine bed before and after the weight reduction and conclusions were drawn about the optimized design. [2]

Dr. V.S.S. Murthy, P. Sreenivas, “CNC PART PROGRAMMING AND COST ANALYSIS ON VERTICAL MACHINING CENTRE (VTC)”, International Journal of Modern Engineering Research (IJMER), Vol. 3, Issue. 4, July-august. 2013.

In the present study in view of the latest development and revolutionary changes taking place in CNC field through the world, Mechanical elements have to be designed and manufactured to precision, which is perfectly and easily possible through these modern CNC machines. This work is based on the capacity and capability of vertical machining Centre with auto tool changer. The top slide which was part programmed can be machined using VTC. And Machining Time is compared in between carbide and hardened tools. The “Top slide” of lathe’s called for powerful NC programming technique were used absolute position type data input system using G codes, M codes, polar coordinate programs, circular and linear interpolation, canned cycles etc. The above mentioned component – top slide being manufactured by using various Conventional machine tools like horizontal milling, vertical milling, surface grinding, boring machine and slotting machines. This involved a considerable lead time and usually delayed the assembly schedule. It has been modified and adopted for regular production on this machine, in two

setups there by boosting their productivity and ensuring quality in each and every piece. Finally, we can establish for regular production. [3]

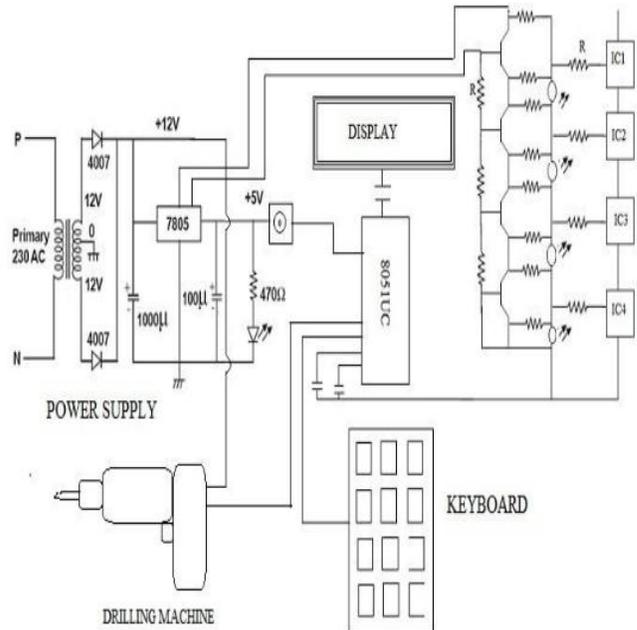
Prof.Ms.A.A.Shingavi, Dr.A.D.Dongare, Prof. S.N.Nimbalkar, “Design of Multiple Spindle Drilling Machine”, International Journal of Research in Advent Technology “ICATEST 2015”, 08 March 2015.

This paper discuss the case study and comparison of productivity of component using conventional radial drilling machine and special purpose machine. The growth of Indian manufacturing sector depends largely on its productivity & quality. Productivity depends upon many factors, one of the major factors being manufacturing efficiency with which the operation/activities are carried out in the organization. Productivity can be improved by reducing the total machining time, combining the operations etc. In case of mass production where variety of jobs is less and quantity to be produced is huge, it is very essential to produce the job at a faster rate. This is not possible if we carry out the production by using general purpose machines. The best way to improve the production rate along with quality is by use of special purpose machine. Usefulness and performance of the existing radial drilling machine will be increased by designing and manufacturing of multispindle drilling head attachment. This paper deals with design and development of multispindle drilling head for cycle time optimization of the component. Kumara B , M. Mohan Ram, “DESIGN AND FABRICATION OF LATHE FIXTURE FOR BRAKE DRUM (cargo) MACHINING”, International Journal of Scientific and Research Publications, Volume 4, Issue 7, July 2014. This survey report is prepared based on the common observations that we have when we observed some small scale industries that use drilling machines for mass production. As

per their versions we came to know that the work is delayed because of inadequate drilling machines. They need programmable type of automated special purpose drilling machines for different drilling applications; in this regard we decided to develop one such type of drill machine for mass production applications. There are a number of types of special purpose drilling machines available in the market, most of them are imported, and therefore economy point of view it is going to be a big burden for entrepreneurs. Special purpose drilling machines include machines capable of drilling multiple holes at once or drilling holes at different places one after another in a sequence. For mass production applications, high-speed drilling machines are essential; in this field the most popular machine is CNC. These are very costliest machines. To avoid this costliest affair & to develop indigenous technology, this project work is taken up for the benefit of our industrialists. [5]

2 EXPERIMENTAL VALIDATION

This circuit consisting of 12 keys is aimed to generate drilling depth information in millimeters. Out of 12 keys, 10 keys are utilized to raise drilling data through numeric numbers of 0 to 9. The 11th key is used as clear key, & the 12th key is used as start/go key. After entering the data and by activating the go key, the machine starts & performs the function of drilling. The micro-controller (consisting of processor, RAM and EPROM, and three ports) takes care of hardware and software, when the keyboard is interfaced to it. In this concept, the micro-controller scans the keys continuously, i.e., the function of programs stored in the EPROM through the keys. The micro-controller monitors the keyboard continuously & detects the activated key automatically. Controller is programmed to store the data of activated keys information in to its EPROM.



The source of information is keyboard; the digital information produced by the keyboard is converted in to digital code. Here the micro-controller is playing a major role for converting the logic signals into digital codes. To detect a pressed key, the micro-controller makes high all rows by providing logic high at input, and then it reads the columns. If the data read from the columns all zeros, no key has been pressed and the process continues until a key press is detected. When any key is pressed, the micro-controller detects and goes through the process of identifying the key. Starting with top row, the micro-controller reads all the columns. If the data read is all zeros, no key in that row is activated and the process is moved to next row. This process continues until the row is identified. After identification of the row in which the key has been pressed, the next task is to find out which column the pressed key belongs to. This can be achieved, because the micro-controller knows at any time which row and column are being accessed. All the rows are connected to one port of

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microcontroller and all the columns are connected to another port of same microcontroller. The keyboard contains press to on type micro-switches having four pins and remains in normally open condition, when the key is pressed normally open contact gets closed to generate activated signal and this signal is fed to microcontroller. These switches are nothing but feather touch keys, popularly known as „button keys“ .

OPERATION:

Drilling is the operation of producing circular hole in the work-piece by using a rotating cutter called DRILL. The most common drill used is the twist drill.

A drilling machine can be called a drill press is used to cut holes into or through metal, wood, or other materials. Drilling machines use a drilling tool that has cutting edges at its point. This cutting tool is held in the drill press by a chuck or Morse taper and is rotated and fed into the work at variable speeds. Drilling machines can also perform countersinking, boring, counter boring, spot facing, reaming, and tapping. Drill press operators must know how to set up the work, set speed and feed, and provide for coolant to get an acceptable finished product. All drilling machines have the following construction characteristics: a spindle, sleeve or quill, column, head, worktable, and base. The spindle holds the drill or cutting tools and revolves in a fixed position in a sleeve. In most drilling machines, the spindle is vertical and the work is supported on a horizontal table. The work piece is held stationary i.e. clamped in position and the drill rotates to make a hole. Based on construction types, these machines can be categorized into portable, sensitive, radial, up-right, gang, & multi-spindle. Based on the feed all above machines can be divided into two sections, Hand driven & Power driven.

The following are the components of drilling machine:

Spindle:

The spindle holds the drill or cutting tools and revolves in a fixed position in a sleeve.

Sleeve:

The sleeve or quill assembly does not revolve but may slide in its bearing in a direction parallel to its axis. When the sleeve carrying the spindle with a cutting tool is lowered, the cutting tool is fed into the work: and when it's moved upward, the cutting tool is withdrawn from the work. Feed pressure applied to the sleeve by hand or power causes the revolving drill to cut its way into the work a fraction of an mm per revolution.

Column:

The column is cylindrical in shape and built rugged and solid. The column supports the head and the sleeve or quill assembly.

Head:

The head of the drilling machine is composed of the sleeve, a spindle, an electric motor and feed mechanism. The head is bolted to the column.

Worktable:

The worktable is supported on an arm mounted to the column. The worktable can be adjusted vertically to accommodate different heights of work or it can be swung completely out of the way. It may be tilted up to 90 degree in either direction, to allow long pieces to be end or angle drilled.

Base:

The base of the drilling machine supports the entire machine and when bolted to the floor, provides for vibration-free operation and best machining accuracy. The top of the base is

similar to the worktable and may be equipped with t- slot for mounting work too larger for the table.

Hand Feed:

The hand- feed drilling machines are the simplest and most common type of drilling machines in use today. These are light duty machine that are operated by the operator, using a feed handled, so that the operator is able to “feel” the action of the cutting tool as it cuts through the work piece. These drilling machines can be bench or floor mounted.

Power feed:

The power feed drilling machine are usually larger and heavier than the hand feed ones. They are equipped with the ability to feed the cutting tool in to the work automatically, at preset depth of cut per revolution of the spindle. These machines are used in maintenance for medium duty work or the work that uses large drills that require power feed. Larger work pieces are usually clamped directly to the table or base using T –bolts and clamps by a small work pieces are held in a vise. A depth –stop mechanism is located on the head, near the spindle, to aid in drilling to a precise depth.

One of the important and commonly used drilling machine is Sensitive drilling machine.

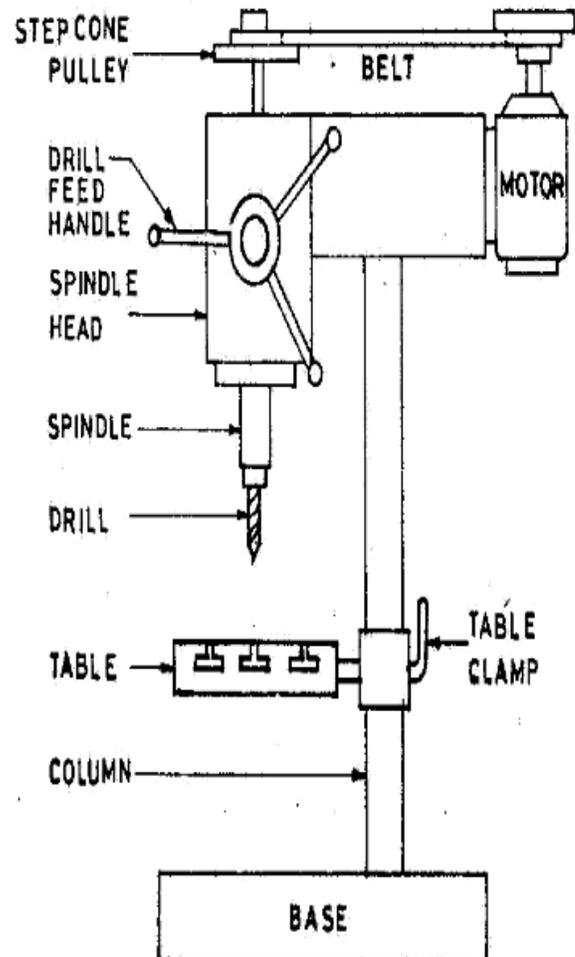
Sensitive or Bench Drilling Machine:

This type of drill machine is used for very light works. The following is the machine sketch of sensitive drilling machine.

The following are the features of sensitive drilling machine

- The vertical column carries a swivelling table the height of which can be adjusted according to the work piece height.
- The table can also be swung to any desired position.

- At the top of the column there are two pulleys connected by a belt, one pulley is mounted on the motor shaft and other on the machine spindle.
- Vertical movement to the spindle is given by the feed handle by the operator.
- Operator senses the cutting action so sensitive drilling machine.
- Drill holes from 1.5 to 15mm

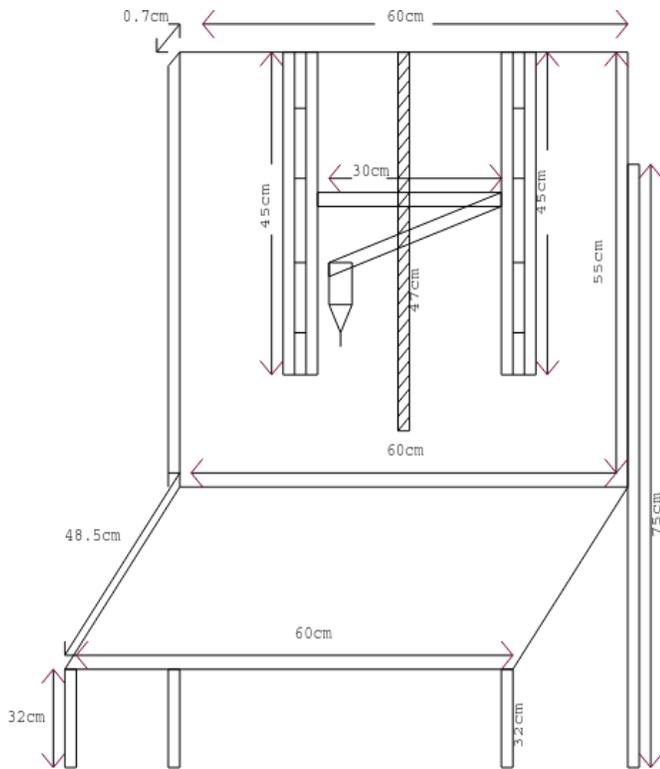




Performance Data at Rated 12V DC

Type	No-Load Speed	Rated			Peak Torque N.m	L1 mm	L2 mm
		Speed rpm	Current A	Torque N.m			
WD1160	40	28	5.6	5.2	8.5	182	225
	31	24	4.8	7	10		
WD1160-B	40.5	28	5.8	6.5	10	199	235
	27	21.5	6.3	13.2	15		

2.3 DESIGN OF PROJECT



DIMENSIONS:
 Length of ply= 55cm
 Width of ply= 60cm
 Thickness of ply= 0.7cm

CALCULATION OF ULTRASONIC MODULE:

The Ultra Sonic sensor emits ultrasound at 40,000Hz that travels in the air. If there is an object or obstacle in its path, then it collides and bounces back to the Ultra Sonic module.

The formula **distance = speed*time** is used to calculate the distance.

Suppose, an object is placed at a distance of 10 cm away from the sensor, the speed of sound in air is 340 m/s or 0.034 cm/μs. It means the sound wave needs to travel in 294 μs. But the Echo pin double the distance (forward and bounce backward distance). So, to get the distance in cm multiply the received travel time value with echo pin by 0.034 and divide it by 2.

The distance between Ultra Sonic sensor and an object is:

Speed of sound:-

Speed=340 m/s=0.034cm/s

Time = Distance / Speed

Time = 10/0.034us = 294us

Distance = Speed * Time

2

Distance = 0.034 * 294

2

Distance= 4.998 m

Example:

Suppose we want to drill the hole of depth 5cm. Then set the value of 5cm using increment and decrement key of project. Ultrasonic module will calculate the distance between object and module and the drilling machine will start through motor. After drilling the motor will automatically stop after reaching the maximum set value.

Block Diagram

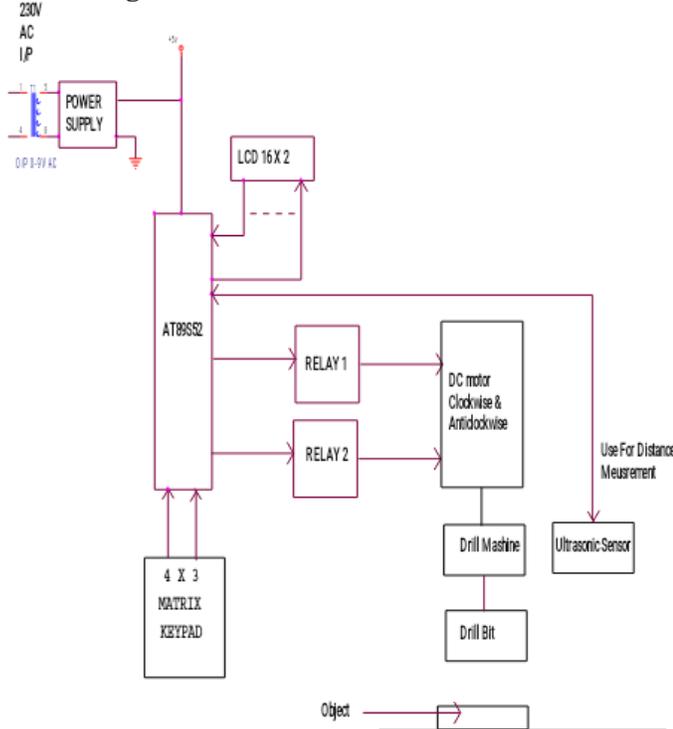


Fig: Block diagram

3.2 Working

The project work “Programmable drilling depth control machine” is mainly aimed to do the job of drilling work at mechanical workshops. The procedure is described in this chapter as per block wise.

The machine is designed with a drilling motor, and the motor functions independently. Drilling depth of the motor can be

programmed through the keyboard. The drilling motor is moved in vertical direction through power feed technology designed with stepper motor. The stepper motor used to move the drilling motor up & down directions is aimed to pull down the drill motor while drilling the hole over the job. Here some force is applied such that the machine can be able to drill the hole over light metal jobs. The main purpose of this machine is to control the drilling depth accurately; therefore the control circuit should be able to recognize the target entered through keyboard. Based on the data the controller can be programmed through keyboard. Now the controller can recognize the movement of mechanism by counting the pulses internally. The entire vertical moving mechanism that contains drilling motor is coupled with power feed motor can be called as depth control mechanism.

OVERVIEW OF PROJECT

1.1 Advantages

1. Depth will be properly measured and drilled.
2. Multiple operations can be performed at same time.
3. Permutation of operations can be performed at same time.
4. Compact in size, low weight and stable
5. Low cost of manufacture.
6. Material loss will be reduced.

1.2 Disadvantages

1. A small error in programme can make the machine to work improper.
2. Overheating of electronic parts may burn them.
3. Excessive load than the capacity of stepper motor may damage the coils of the motor

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5.3 Future work

- Now a days the multispindle drilling machine used are operated by single lever, which control all spindles at a time.
- The new idea is that, we can operate two or three spindles at a time according to requirement.
- In conventional drilling machine distance is not available on screen user don't have any feedback so we use these type of machine.
- Feedback of drilling distance will be given.

In order to overcome all the problems which are occurred in the drilling, the automated drilling machine using the sensors is useful. We develop this machine using DC motor, Drill machine assembly, serial communication connector to give the proper drill

CONCLUSION

Drilling machines or drill presses are one of the most common machines found in the machine shops/mechanical workshops. A drill press is a machine that turns and advances a rotary tool into a work piece. The drill press is used primarily for drilling holes, but when used with the proper tooling, it can be used for a number of machining operations. The most common machining operations performed on a drill press are drilling, reaming, tapping, counter boring, countersinking, and spot facing. These are quite common machines & available everywhere, but for specific applications we need special purpose drilling machines. Availability of these machines in our country is critical; we may have to import them, for which we have to spend lot of amount. In this regard it is essential to develop special purpose drilling machines indigenously; therefore this project work is taken up.

This project revealed that building a relatively low cost, high precision drilling machine named as “**Programmable drilling depth control machine**” designed for workshops is aimed to offer benefits to the Industrialists. Since it is a prototype module, the system is designed with a single drilling motor; there by it can perform single operation at an instant. To enhance the technology further & to make it more comfortable, drill motors can be increased such that a particular specific task can be achieved with the single machine, therefore it can be used for more applications.

To prove the concept practically, a prototype module is constructed for the live demonstration, & results are found to be satisfactory.

REFERENCES

1. A.S.Udgave, Prof.V.J.Khot, “Design & development of multi spindle drilling head (msdh)”, IOSR Journal of Mechanical and Civil Engineering (*IOSR-JMCE*).
2. B. Malleswara Swami, K.SunilRatna Kumar, “DESIGN AND STRUCTURAL ANALYSIS OF CNC VERTICAL MILLING MACHINE BED”, *IJAET/Vol.III/ Issue IV/Oct.-Dec., 2012/97-100*.
3. Dr. V.S.S. Murthy, P. Sreenivas, “CNC PART PROGRAMMING AND COST ANALYSIS ON VERTICAL MACHINING CENTRE (VTC)”, *International Journal of Modern Engineering Research (IJMER), Vol. 3, Issue. 4, July-august. 2013*.
4. Prof.Ms.A.A.Shingavi, Dr.A.D.Dongare, Prof. S.N.Nimbalkar, “Design of Multiple Spindle Drilling Machine”, *International Journal of Research in Advent Technology “ICATEST 2015”, 08 March 2015*.
5. Kumara B , M. Mohan Ram, “DESIGN AND FABRICATION OF LATHE FIXTURE FOR BRAKE

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DRUM (cargo) MACHINING”, International Journal of Scientific and Research Publications, *Volume 4, Issue 7, July 2014.*

6. Mechatronics and Measurement Systems By: David g. Alciatore, Michael B. Histan.
7. Mechatronics – Electronic Control Systems in Mechanical and electrical Engineering – By: W. Bolton.
8. Mechanism and Machine Theory By: J.S. Rao, R.V. Dukupati
9. Introduction to Robotics By Saeed B. Niku
10. The 8051 Micro-controller Architecture, programming & Applications By: Kenneth J. Ayala.