Automated Drilling Machine with Depth Controllability

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Abstract: Estimating the drilling depth while drilling manually through a conventional drilling machine is extremely impossible, often the job will be failed due to the over drilling. In many cases, after completing the drilling work, it is very difficult to measure the depth; especially thin holes depth can't be measured. Therefore an automatic drilling machine that performs the function of drilling according to the drilling depth generated & forwarded to the control circuit is essential; hence this project work is taken up, which exposes the technology of special purpose drilling machines.

The Electrical drilling machine designed here is quite useful for mechanical workshops. The machine is constructed with power feed technology is aimed to drill the job up to certain specified depth, For ex: if a particular piece of job is supposed to be drilled to a limited depth, doing it manually consumes lot of time, because every time depth has to be measured through a crude method, thus estimating the drilling depth is quite complicated. For this reason this machine is designed &its mechanical movements are restricted by programming the drilling depth through a potentiometer interfaced with microcontroller.

Keywords: Mechatronics, Limit switch, Motor shaft, Mechanical transmission section, Depth control mechanism.

1. INTRODUCTION

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. According to our survey report, we came to know that the machine designed here with a drilling machine is quite new, & there is no substitute available in the market.

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 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.

2. BLOCK DIAGRAM & ITS DESCRIPTION

The main concept of this project work is to design & develop one special purpose-drilling machine, which can be used to drill the job with different depths programmed independently. These kinds of drill machines are very much required in the mechanical workshops, where it is essential for specific job applications. Drilling depth of the motor can be programmed through the potentiometer. 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 upward & downward 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. Since the project work is considered as prototype module, the stepper motor used here can apply a little force. To drill over heavy metals like MS, high power motor with suitable gear mechanism is essential.

The main purpose of this machine is to control the drilling depth accurately; therefore the control circuit should able to recognize the target entered through potentiometer. In this regard, the vertical moving mechanism is coupled to the stepper motor shaft, as this motor rotates step wise & step angle is 1.8^o, the movement of mechanism per step can be measured. Each pulse produced by the controller can rotate the motor by one step, since step angle is 1.8^o, 200 pulses are required to rotate the motor for one full revolution. When the stepper motor completes one full revolution, initially movement in the vertical mechanism must be measured with the scale. Based on this data the controller can be programmed through keyboard. For example, if the power feed motor (stepper motor) completes one revolution assume that the mechanism is moved by 1mm down, to move the mechanism by 1mm the controller has to produce 200 pulses. 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.

The depth control mechanism coupled to the drilling machine can be used for drilling to a desired depth; the desired depth can be programmed through a potentiometer interfaced with controller chip. This technology prevents the twist drill from traveling too far after cutting through the work piece. The depth control mechanism was designed to be used whenever a number of holes of the same depth are to be drilled, or when drilling holes deep into the work piece. Make sure that drills are chucked tightly to avoid slipping and changing the depth setting. Most depth stops have a way to measure the distance that the drill travels. Some may have a fractional gage on the depth stop rod, and some may have a micrometer dial located on the depth stop for very precise measurements. But here in this concept depth control machine can be programmed such that no tool is required for measuring the depth. Once it is aligned, it can be used for mass production.
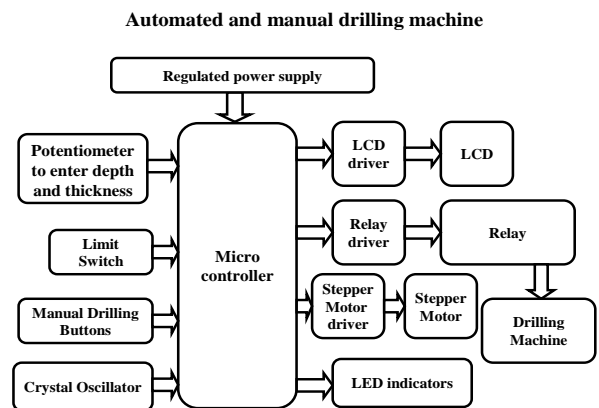
Automated and manual drilling machine

Figure 1. Block Diagram

3. CIRCUIT DIAGRAM & ITS DESCRIPTION

The project "Automated Drilling Machine with Depth Controllability" using PIC microcontroller is an exclusive project which is used for automatic control over drilling depth by a microcontroller based system. According to the program dumped onto the microcontroller, the drilling machine, stepper motor and other devices starts working to obtain the successful output. When the power is supplied to the setup, the 230V supply is converted to constant 5V and then supplied to the microcontroller and its components. With the help of a potentiometer the inputs (i.e., depth of the hole to be drilled & thickness of the object) are given. The display section is designed to display the drilling depth data of the drilling motor. For this purpose an LCD panel is used & it is interfaced with microcontroller through its output port. This display is having two rows & each row can display 16 characters. The drilling depth data of the motor is entered in mm through the potentiometer, & is displayed on the LCD.

Relay is an electrically operated switch that is used to drive the ac devices (drilling machine).

The most important electrical device used in the project work is Stepper motor. In a stepper motor, the electromagnets are energized by an external control circuit, such as a microcontroller. To make the motor shaft turn, first one electromagnet is given power, which makes the gear's teeth magnetically attracted to the electromagnet's teeth. When the gear's teeth are thus aligned to the first electromagnet, they are slightly offset from the next electromagnet. So when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one, and from there the process is repeated. Each of those slight rotations is called a "step," with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle. Stepper motors are ideally suited for precise positioning of an object or precise control of speed without having to resort to closed loop feedback. These motors rotate in step-wise i.e., this stepper motor rotates a precise angular distance, one step for each pulse that is delivered to its drive circuit. The motor used in this project work has a step angle of 1.8^0 per pulse. In order to rotate the motor shaft for one complete revolution i.e., 360^0, it is required to supply 200 pulses ($360 / 1.8^0 = 200$) to the motor's drive circuit. This drive circuit is then connected to drilling machine, which is the main device of the project. Drilling machine rotation & movement is based on the stepper motor rotations.

For identifying the home position of the drilling machine & to restrict the vertical movement at top position, limit switch is arranged to the structure. This switch is interfaced with microcontroller as input signal. This limit switch is having long lever & when little pressure is applied to the lever, switch will be activated automatically. The mechanical transmission section that carries the drill motor activates the switch at home position. Whenever the limit switch is activated, active low signal will be generated, based on this signal the microcontroller can recognize the position of drill motor. Thus the power can be saved to a maximum extent.

In this project based on thickness & depth entered, the drilling machine drills the hole into the object that is placed under the drill-bit. Thus the desired hole of desired depth is obtained, hence the name "Automated Drilling Machine with Depth Controllability".
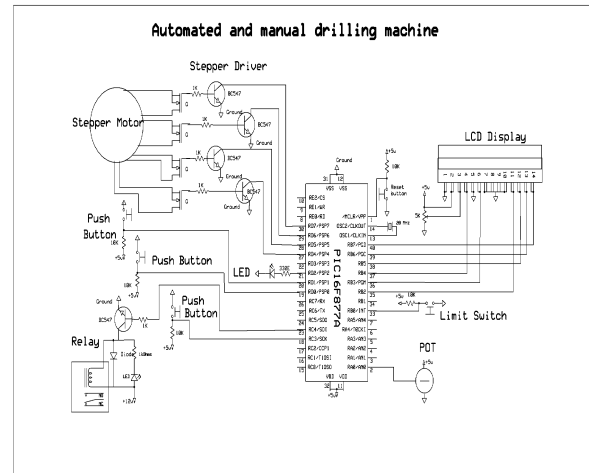

Figure 2. Schematic Diagram

4. RESULT

The project "**Automated drilling machine with depth controllability**" was designed such that the drilling depth is controlled automatically to set value by microcontroller based system.
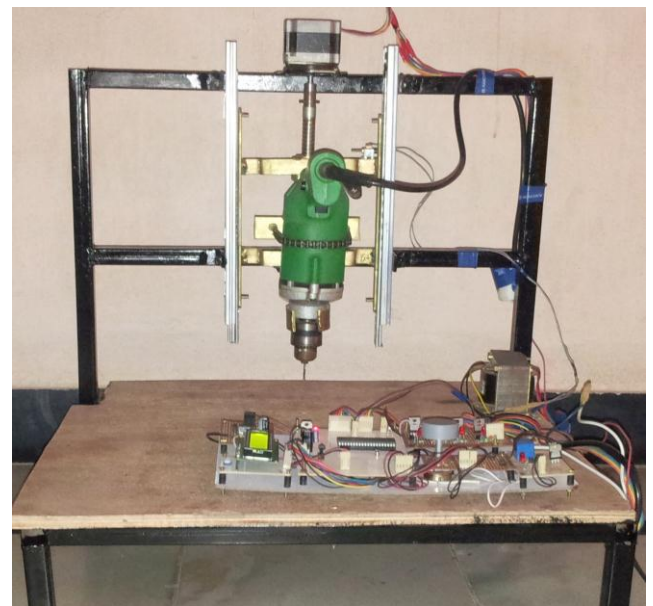

Figure 3. Automated & Programmed Drilling Machine

5. CONCLUSION

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been

successfully implemented. Thus the project has been successfully designed and tested.

6. ACKNOWLEDGMENTS

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