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360º Flexible Drilling Machine (Using 3D Printed Parts)

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ABSTRACT: In basic drilling machines, there is a problem of limitation of movement of drilling machine in different directions. Also, there are problems of less space between drill bit and job and due to this we use hand drills in these cases but it causes alignment problems. We can overcome these problems with the help of a 360°flexible drilling machine. It can be mounted on a flat surface and can be rotated in horizontal, up and down. So that job setting operation is not complicated. It reduces the setting time for the operation. Materials like wood, plastic and soft material can be drilled with this machine. A robotic arm mechanism with 3D printed parts are used which will be controlled by servo motors connected with controllers to control each axis of the arms for smooth and 360° rotation.

KEYWORDS:3D Printed parts, 360° rotation, servo motor, controllers.

I. INTRODUCTION

Drill machines have been the heart of every industry. Drilling can be called as the operation of producing a cylindrical hole of required diameter and depth removing metal the rotating edges of a drill. The cutting tool known as drill is fitted into the spindle of the drilling machine. Drilling holes in parts, sheets and structures is a regular industrial work. Perfect and well aligned drilling needs fixed and strong drills. Some parts cannot be drilled using fixed drills due to low space between drill bit and drill bed. We need to use hand drills in such cases but hand drills have alignment problems while drilling. So here we propose a flexible drill that can be mounted on a table or wall and can be used to drill holes horizontally, even upside down. So, this makes it possible for easy drilling in even complicated parts and surfaces. Thus, use of 3D printed parts ofPLA+ (polylacticacid or polylactide) material. Servo Motors with faster response and greater torque to control the arms rotation. Controllers are used which are connected to the arm links where servo motors are attached to control machine's movement and reach.

Drilling machine is one of the most important machine tools in a workshop. It was designed to produce a cylindrical hole of required diameter and depth on metal work pieces. Though holes can be made different machine tools in a shop, drilling machine is designed specifically to perform the operation of drilling and similar operations. Drilling can be done easily at a low cost in a shorter period of time in a drilling machine. A mark of indentation is made at the required location with a centre punch. The rotating drill is pressed at the location and is fed into the work. The hole can be made up to a required depth. Drilled holes are characterized their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks. Drilling may affect the mechanical properties of the work piece creating low residual stresses around the whole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface.

[1]USING 3D PRINTED PARTS:

3D Printing/additive manufacturing is the development of a three-dimensional object from a digital file. It is a host of technologies that enable a vast spectrum of capabilities for the production of parts and products. Some argue that 3D Printing and its services will be a crucial factor in the industry 4.0 revolution. Differing from subtractive manufacturing which involves cutting out material, additive manufacturing builds the object from the ground up, the layer at a time; thus, enabling complex shapes with significantly lower wasted

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material than traditional technologies. Experts in the
field of manufacturing agree that today we are just beginning to see the true potential of 3D Printing technology. In our project we have used 3D printed parts of PLA+ (polylactic acid or polylactide) material for good flexible and durable parts so that the machine can be light weight and cost efficient.

[2] DRILLING MACHINE CONSTRUCTION:

The basic parts of a drilling machine are its base, supporting arms, drill head and chuck. The base made of wood rest on the floor depending upon the design. The shoulders are sticked on base with the help of feviglue. It is accurately 3D Printed and the arms can move up, down and rotate about in Horizontal direction. chuck at different speeds is mounted on the top of the upper arm. Power is transmitted from the 12V DC motor connected to an adapter through cable wire to the drill chuck.

[3] DRILLING MACHINE PRINCIPLE:

The working principle of this flexible drilling machine is initially started from the base connected with servo motor and each arm and shoulder connected with MG996 motor each servo motor is further connected with controller. In which each controller is connected to 5V Adapters through cable wire. Then the arm rotates at 360 degree and moves anywhere when drilling is required up to its maximum arm length. With the help of our project, we can drill in complicated parts accurately.

II. LITERATURE REVIEW

From the literature study we can conclude that in basic drilling machines there is a problem of rotation of arms in 360-degree direction. Also overcoming the complication of space between drill bit and job work is an issue. Further there is lack of strong base model and free movement of machine to conduct other mechanical operations if needed and drilling in horizontal complicates varied use of the machine. Mounting also seems to be an obstacle as machine is heavy and cannot be mounted for tough drilling spots.

Use of 3D printed ABS parts is a concept to look forward to with servo motor and controller enhanced system to reduce overall cost and increase productivity.

III. MATERIALS AND METHODS

Our project can rotate 360° and can drill hole horizontally and up down direction. It is a portable machine so that job setting operation is not complicated as well as reduces the setting time for the operation. It also takes into drilling machine by manually. Materials like wood, plastic and softer materials are drilled with this. We have used 3D printed parts as they are cost effective and precisely machined with zero defects.

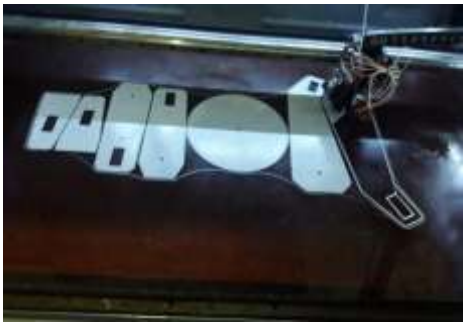

Fig-1 3D printing of parts

4 arms and 2 supporting shoulders are used which are mounted on circular base attached to the wooden base and a 360° driven servo motor which will make the machine rotate 360 degrees. Each link between the arms is connected to servo motors connected to controllers so that their movement can be controlled manually and automatically. All controllers are connected to a battery output or an alternative source of current of 12V or higher.

The base is made out of wood in which a 360° motor is placed which is connected to the circular base that drives the machine to rotate 360°. Furthermore, the arms are interconnected with supporting shafts and linked with each other through servo motors. An electric drill is connected to the wrist of the upper arm by a supporting clamp driven by servo motor attached at both sides for perfect and smooth drilling with less vibrations.

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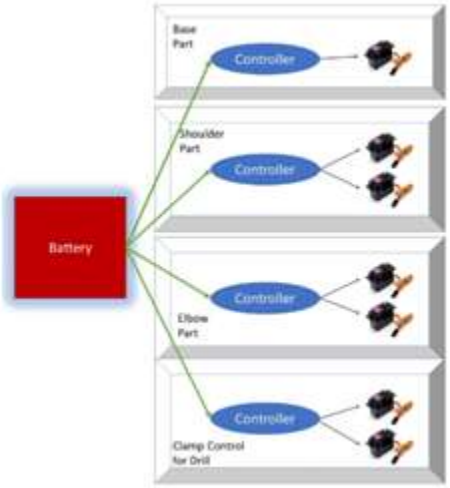


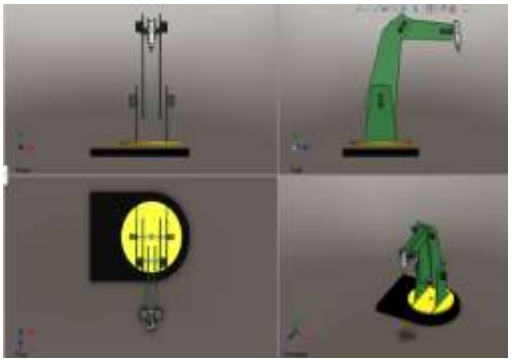
Fig- Connection of controllers and controllers

[A] HARDWARE COMPONENTS LIST

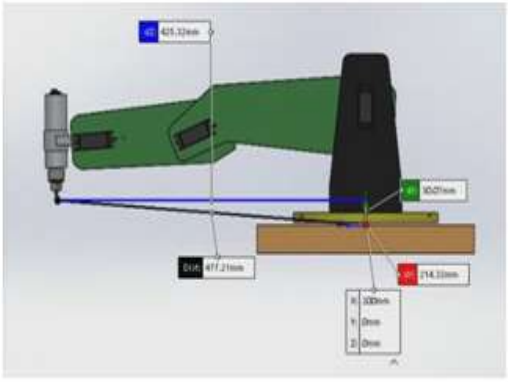
Components	**Nos.**
Servo motor MG996R	7
Multi servo 3CH ECS	4
DC Motor	1
Chuck	1
Drill bits (0.5mm – 3mm)	5
Battery(6-9V)	1
Battery 12V	1

Body parts (3D Printed)	**Nos.**
Polylactide plus (PLA+)	1 kg
Circular base	1
Shoulders	2
Arms	4
Base(wooden)	1
Support clamp for drill	1

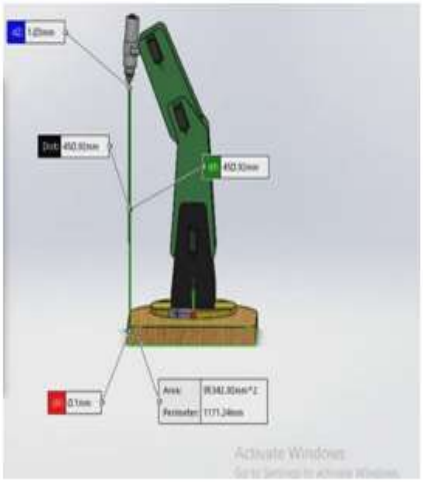
IV. DESIGN



The machine has a horizontal reach of **425mm** from its centre.



The machine has an upward reach of **450mm** from the base.



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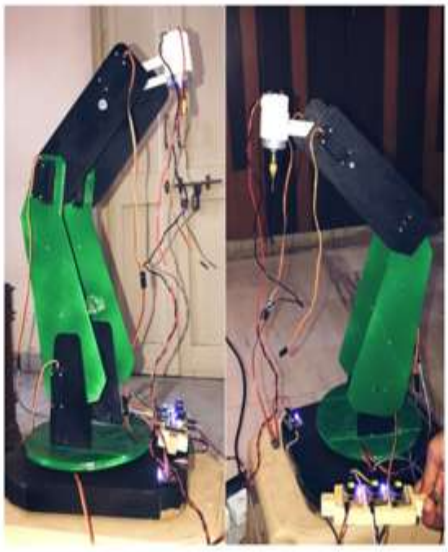
V.CONCLUSION

In this project, we have checked the working of our project we connected the arms with servo motors and servo motors to the 3CH ECS controller giving it a 4 amp. power supply. Furthermore, we mounted it on a wooden base clamped with a 360° motor and connected with circular base. The drill chuck connected with DC motor of 12V for drilling of various hole of dia. 0.5mm-3mm. Also, by controlling through the controller the machine lifts itself and drills in horizontal or upward direction controlled through the controller switches and rotates in 360° direction. Any layman can use this machine as it is portable and light in weight plus easy to use.



FUTURE SCOPE

It can be further on designed with the method of 360-degree rotation of arms which can be used for other machining operations. Ex: - Milling and Tapping. Also, using advance programming and a toggle switch in future would be an advancement in the machine. Robotic arms can be used in future for faster movement.

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