3D WIRE BENDING MACHINE

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ABSTRACT

This paper proposes the prototype of 3D printed wire bending machine using Arduino uno microcontroller which is flexible as well as capable to make bends for Industrial applications. Till recently many wire bending applications were performed manually and even if there is wire bending machine there are too costly to afford. Wire banding machines has a tendency of making errors which affects the efficiency of wire. As well as elongation of the treatment time. In general, the accuracy of the bend is depending on many factors mostly on the expertise of the operator of machine. Hence because of these limitations in the manual wire bending machine this project proposes the system that can be used to make bends on wire with high efficiency with the help of Arduino uno microcontroller.

Key Words—Modern bending machine, Affordable, flexible, micro-controller

INTRODUCTION

In product development cycle prototyping is very important stage. For designer and engineer prototyping tools allow them to make functional models or products quickly and inexpensively. New additive technologies like subtractive manufacturing tools and 3D printing allows fast and accurate. Manufacturing of different prototype components. These technologies allow designers to bring their ideas and imaginations into real world much faster. Another emerging method of rapid prototyping is wire bending. Wires are bent by CNC system to create parts in large assemblies. Wire frames are useful for creating negative spaces in assemblies that can be filled with other material. Wire bending is often much faster than 3D printing, and its use of metal material is less dangerous than that of laser cutting or subtractive manufacturing methods. Wire bending machines completes its work one of the two ways, Which involves feeding wire through a channel to create bend. large industries bender uses a number of different bend head to create bend of different radius or shapes. These heads have two pins which grip the wire and turn to a specific angle for creating a bend. These machines, while precise, versatile, and fast are large as well as expensive. They required special training to use and only meant for large environments. A more affordable method of bending is similar to the griper method. In this only one pin rotates around the end of the fixed tube through which wire is feed. While this method has been scaled down to the desktop size production of this technologies is limited to only 2 dimensions. This drawback limits the variety of shapes a bender can make. Due to the disadvantages of the current wire banding technology made this somewhat unpopular in the world of rapid prototyping, however this market gap can be filled with the development of an affordable, desktop size 3D wire bending machine that is easy to use and can bend many different materials.

PROBLEM STATEMENT

Current wire bending technology limits the user to only 2D structures. Other approaches to 3D bending have issues such as uncertain feeding or are extremely expensive. To overcome these issues to design all the parameters we attempt to create a prototype capable of consistently bending a wire in 3D while avoiding collisions.

OBJECTIVES

A. The main objective of this prototype is to develop efficient and automated and 3D wire bending machine.
B. To design and develop cost-effective 3D wire bending machine.
C. To develop 3D wire bending machine with a higher integration and production efficiency.

METHODOLOGY

Once the topic was selected, we started searching for the research papers online. We found many works which is done on this topic. After reviewing those research paper and market surveys we found 2 major problems related to the wire bending machine.

First problem was till recently wire bending operation is perform manually which creates too many errors as it is done by the human operators and the accuracy and efficiency is too low as manual wire bending has a huge tendency to create errors. also, it parallelly increases treatment time. Second problem was there are machines available for bending the wire, but they are too expensive to afford. Small scale workshops cannot afford these high-tech machine as it will also increase their maintenance cost and they will have to hire skilled operators to operate those machines.

After Reviewing all the details, we decided to make a small desktop site 3D printed wire bending Machine whose main objective will be to increase production with high efficiency and high accuracy at Low cost. To make our project Reality we started by Designing the model on solidworks software which is a best software in his field. After designing We now knew how our project was going to look like. We use 3D printer to print gears and started making our base of the project. We brought all the parts necessary.

The main problem in our project was programming the Arduino board to run like we wanted it to. After Many tries, we finally made a program which could satisfy our need that is making a star shape design. After all the assembly now, our project was ready to test. After many test and error method and making lots of adjustment our machine was working as we initially planned.

WORKING

first of all, we connect the Arduino uno microcontroller to the power supply. Than to operate the Arduino uno mi- controller we connect it to the PC or laptop. To control the Arduino, we used Arduino IDE. Then we checked if the Arduino is properly connected or not by checking their port in IDE. By opening the Arduino IDE terminal, we can reset the plunger position to its original position When we type the star function in the terminal the prototype starts to work. The aluminium coated wire starts to feed in forward direction as it passes through the guiding rollers. After passing through the guide rollers, it passes to the straightener rollers. The purpose of straightener roller is to straighten the wire as to avoid the unnecessary bent in wire. Here Arduino microcontroller helps to feed the exact amount of wire as mentioned in the program. Once the wire passes through the nozzle servo motor starts operating. Plunger is connected to the servo motor which enables the upward and downward movement of the plunger. Here Arduino commands the servo motor to bend the wire at a required angle and distance as mentioned in the program. When all the required bends are made the program automatically ends and we can cut the wire at the end to get our required product. Here we can program our microcontroller in such a manner that typing the star function we start executing the whole process. For different shapes we can set different variables while programming to execute the command.

Fig. 1. Prototype of 3D Wire Bending Machine

RESULTS

After testing our prototype machine. The machine was able to bend a 3 mm aluminium coated wire into a star shape in just a minute with minimum effort of typing "star". We noticed that due to overhanging wait of the wire the wire was falling downside which leads to the errors in the bending process because of which we needed to support it. Since the gears are not strong enough, we were not able to bend hard material due to our fear that the 3D printed gears would fail under the stress needed to bend the material. Our real goal was achieved of making a prototype of the 3D wire bending machine.

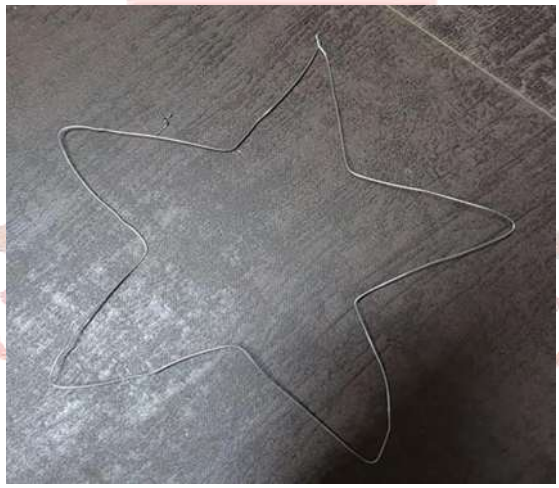

Fig. 2. Final Product

CONCLUSION

The presented study is important to reduce errors in manual wire bending machine which effects the cost and time of the treatment. This study might be beneficial to minimize the dependency of skilful benders. Finally, the accuracy and effectiveness of the required shape can be secured during the physical implementation in the latter stage. This contribution is considered significant to the innovation of the wire bending technology.

FUTURE SCOPE

If we had the opportunity to continue working on this design project, there are many things that we would keep in mind. First, we would build the prototype out of stronger materials so the prototype could bend aluminium. A primary reason why we were hesitant to try to bend aluminium was due to our fear that the 3D printed gears would fail under the stress needed to bend aluminium wire. Since gear failure was one of our major risk assessment criteria, we bent aluminium coated wire instead of bending aluminium.

To get more accurate and reliable bends next prototype needs to focus on reducing the slipping of wire as more weight begin to cantilever off of the end. This could be achieved by increasing the spring tension on the feeder or adding another idler further in the system to help the wire stay in place.

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