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Design and Development of 3D Wire Bending Machine using Micro-controller

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ABSTRACT

This project proposes automated 3D wire bending mechanism which is flexible and capable of making any type of bend for industry applications. Till recently, most of the wire bending applications were performed manually and even if wire bending machines are available they can't be afforded. Manual wire bending has a huge tendency to create errors, thus affecting the efficiency of the wire for the specified treatment, in parallel with the elongation of the treatment time. Besides, it can simultaneously increase the bending time due to some additional major adjustments and leads to bender fatigue. In general, the accuracy of the bend is inconsistent and depends on many factors, mostly on the expertise of the bender. Hence, due to these limitations in the manual wire bending and some urgency to decrease the dependency on the bender's competency, this project introduces a system that can be used to create any type of bends on wire with great efficiency with the help of microcontroller based bending mechanism.

Wire bending machines accomplish their task in one of two ways. Both involve feeding wire through a channel to create successive bends. Large, industrial mass- manufacturing benders use a multitude of different bend heads to create bends of different radii and shape. These heads have two pins which grip the wire and turn to a specific angle, these machines, well precise, versatile, and fast as compare to other large and cumbersome machine, as well as very expensive. They require special training to use properly, and are only meant for large manufacturing environments. A more affordable method of bending wire is similar to the gripper method; While this method has been scaled down to desktop sizes, production versions are limited to bending wire in two dimensions. This severely limits the variety of shapes a user can create. The disadvantages of current wire bending technologies have made this technology somewhat unpopular in the world of rapid prototyping, however we believe this market gap can be filled with the development of an affordable, desktop-style 3D wire bender that is easy to use and can bend a variety of materials.

Keywords— 3D Wire Bending, Micro-controller

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I. INTRODUCTION

Prototyping is a vitally important stage in the product development cycle. Prototyping tools allow designers and engineers to quickly and inexpensively create functional models, fixtures, or products. The market for these tools has grown immensely in the past 20 years. New additive technologies like 3D printing and subtractive manufacturing tools like laser cutters and CNC mills and lathes allow fast and accurate manufacturing of many different prototype components. These technologies allow designers to bring their ideas into the real world much faster than was previously possible. Despite their advantages, current rapid prototyping technologies are limited by the maximum sizes of parts they can create and their often high cost.

Wire bending is another emerging method of manufacturing that has enhanced the ability of designers to make use of negative space and frames in assemblies. Performing market research and user interviews showed us that current wire bending tools are either very expensive, or limit the user to two dimensional structures. We believe that this market gap can be filled by an affordable, desktop scale,3D wire bender. With this in mind we were able to develop the needs that we felt were important to achieve in a prototype version of this 3D wire bender.

II. OBJECTIVES

Current affordable, wire bending technology limits the user to two dimensional structures. Other approaches to 3D bending have issues such as collisions and inconsistent feeding or are extremely expensive, so the objectives of this project are

1. To develop efficient and automated 3D wire bending machine.
2. To design and develop cost-effective 3D wire bending machine.
3. To analyses the suitability of the 3D wire bending machine for various applications
4. The 3D wire-bending machine with a higher integration and production efficiency.

III. LITERATURE REVIEW

TANG Wenxian, ZHU Hui, ZHU Mengxiu, LI Qinfeng; ZHANG Jian, [1] Authors focus on studying the wire-bending process, developing a DC wire-bending machine which is used to bend the wire to any angle. The DC wire- bending machine with a higher integration and production efficiency contained storing mechanism, straightening mechanism, feeding mechanism and wire-bending mechanism. The storing mechanism can be reset by itself without being adjusted manually when the feeding speed is different from the receiving speed of the processing equipment. The wire-bending mechanism for double-heads can achieve asymmetric bending. The clamping device of wire-bending mechanism is more stable and higher rotational accuracy.

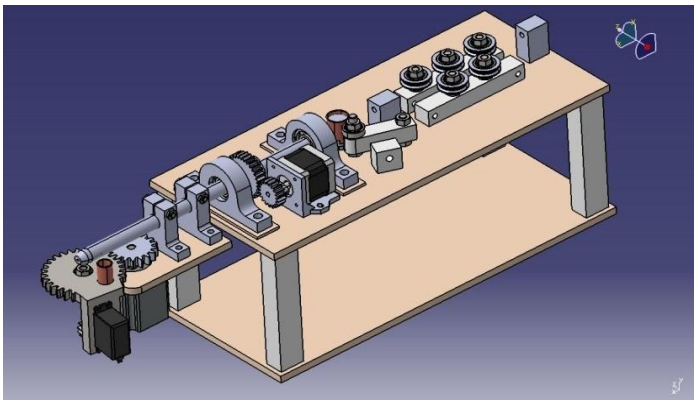
Chen Minghui, Yao Bin, Lin Rongkun, Lu Rusheng, [2] In this paper a method for modeling 3D wire is proposed. We can get a variety of wire models by inputting only 4 parameters repetitively. The bended part of the wire could be regarded as constituted by a limited number of short cylinders and the straight part could be regarded as a long cylinder during the modeling. After the modeling, off-line simulation processing is carried out. By using double buffering technology, we obtain smooth animation during the off-line simulation. Collision detection is carried out during the simulation. To simplify the collision detection algorithm, the author approximates the wire model and the machine model by using line segments and planes. In so doing, the computational cost for collision detection can be significantly reduced. Modeling, simulation and collision detection are well applied in the simulation software the author has developed.

HenrikLavric, MiroslavBugeza, RastkoFiser,[3], This paper describes the problems in nowadays production of ribs, the most important assembling part of lever arch mechanism. The process of wire bending machine upgrade is presented and the control principle for ribs geometry stabilization is proposed. The overall control scheme consists of inner - force control loops and outer – geometry control loop. The inner loops control the force on respective roller of the horizontal and vertical plane of wire straightened according to the predefined reference values. These values are modified with the superior loop in respect of geometry variations of the rib. Required displacements of rollers are obtained using wedge systems driven by stepper motors. The final geometry of rib is analysed by image processing algorithm inside the image acquisition system.

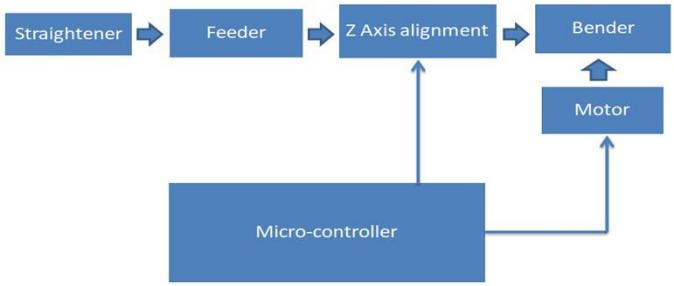
G. Antherieu1, N. Connesson1, D. Favier, P. Mozer, Y. Payan,[4] Journal of the Korean Society of Manufacturing Process Engineers, Vol. 7 No. 4, pp.50 ~55 (2008. 12) Experimental pure bending conditions are difficult to obtain when large deformations and displacements are required. In this work, a new principle using two universal joints is proposed and developed to enable such pure bending conditions. This principle has been applied to design an apparatus suitable to test small size samples (such as wires of diameter < 1 mm) at small curvature radii (5 mm) and to specifically provide small size samples moment-curvature relationship. This article underlines and validates the abilities of this new apparatus by performing and analysing tests on samples made of well-known material.

IV. METHODOLOGY

V. 3D WIRE BENDING MACHINE



VI. BLOCK DIAGRAM



VII.APPLICATIONS

You can find the parts made with 3D wire bending machines in the construction industry. These parts are mainly: reinforced concrete frames, ceiling hooks, safety hooks for scaffolding, etc

In the home appliance industry, examples of components produced with 3D wire bending machines, are: oven grills, cooling coils for refrigerators and freezers, barbecue accessories, bottle holders for refrigerators, parts of baskets for dishwashers, etc

VIII. ADVANTAGES

- Reduces the need for additional operations
- Reduces costs and time
- Allows for unique designs
- Go 3D and get the benefits

IX. CONCLUSION

The following conclusions were drawn from the development:

1. Rotation of the arm has no effect on the movement of the internal parts. A gear arrangement that does not strike is developed.
2. Gear arrangement of drive system can be arranged in parallel Applied to many internal parts movement by developing.
3. Calculation of the number ratio and CNC wire bending machine the validity of the developed drive system was verified through operation.
4. CNC wire bending machine with developed drive can rotate the arm at an infinite angle to speed up work could move internal parts motion directly from servo motor. It can be seen that precise power transmission is possible because it can be controlled.

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