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APPLICATION OF REVERSE ENGINEERING FOR CONVERTING CARTESIAN COORDINATE SYSTEM INTO LASER CUTTING MACHINE

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Abstract - *This paper deals with the application of reverse engineering for converting Cartesian coordinate system into laser cutter. In this project two phenomena are used Cartesian coordinate configuration and LASER. Cartesian Coordinate configuration is used to achieve desired location and LASER used cut the non metals. Nowadays, LASER has become more common tool for cutting and increasingly used in a wide range of industrial applications, replacing more conventional techniques due to many advantages of the LASER over other cutting methods. The key features of this technology include high speed, accuracy, low thermal distortions, and low roughness that reduce the time of finishing operations. In addition, laser cutting have a high degree of beam manipulation and can process and cut complex shapes. It is easily integrated in off-line CAD/CAM systems controlling CNC machines. At present, the majority of cutting applications are in the automotive industry.*

Key Words: *Application of Reverse Engineering, Cartesian Coordinate configuration* robot *, LASER module, Arduino, universal G code sender, grbl , Inkscape.*

1. INTRODUCTION

A Cartesian coordinate robot (also called linear robot) is an industrial robot whose three principal axes of control are linear and are at right angles to each other. A popular application for this type of robot is a computer numerical control machine and 3D printing. The simplest application is used in milling and drawing machines where a pen or router translates across an x-y plane while a tool is raised and lowered onto a surface to create a precise design. Main motto of this study is to convert existing model of Pick and place Cartesian coordinate configuration robot into a *LASER cutter* . The main aim of this project is to make it at lowest possible cost.

This Cartesian Coordinate robot is electrically actuated by using stepper motor for achieving the rotational motions. These motors are controlled by arduino uno 1.8.5 software. The another software required to draw a letter or any sketch using laser module are inkscape, universal G code sender and grbl.

2. LITERATURE REVIEW

1. Optimization and Design of a Laser-Cutting Machine using Delta Robot by B.Moharana, Rakesh Gupta, Bashishth Kumar Kushwaha

Industrial high-speed laser operations the use of delta parallel robots potentially offers many benefits, due to their structural stiffness and limited moving masses. This paper deals with a particular Delta, developed for high-speed laser cutting. Parallel delta robot has numerous advantages in comparison with serial robots: Higher stiffness, and connected with that a lower mass of links, the possibility of transporting heavier loads, and higher accuracy. The main drawback is, however, a smaller workspace. Hence, there exists an interest for the research concerning the workspace of robots in industrial cutting tool maximum do not have more prescribe measurement to cut so that in This paper is oriented to parallel kinematic robots definition, description of their specific application of laser cutting, comparison of robots made by different producers and determination of velocity and acceleration parameters, kinematic analysis – inverse and forward kinematic. It brings information about development of Delta robot. The production of laser cutting machines began thirty years ago. The progress was very fast and at present time every year over 3000 laser cutting machines is installed in the world. Laser cutting is one of the largest applications of lasers in metal working industry.

2. Review on Heat affected Zones, Cut Quality and Comparative Study BY Chithirai Pon Selvan M, Nethri Rammohan and Sachidananda HK

Laser beam machining is a form of non-traditional machining that can machine almost any known materials. It is thermal, non-contact process, which does not induce any mechanical stresses in the work-piece. This paper presents a review on the conclusions of the various research papers available on laser beam machining on the various properties that affect the quality of the process such as heat affected zone formed in the work-piece, laser cut quality and why laser beam machining is more advanced than the other machining processes.

3. Study of Arduino Controlled Robotic System BY K. M. Merlin Ruby , F. Anne Jenefer , D. Vidhya

In the advent growth of new technologies, computer capacity provided realistic opportunity for new robot controls in all aspects in our daily life. This technical improvement requires high performance robots created faster, more accurate and more intelligent robots. In this paper we present a simple Arduino-board based robot that can be driven remotely using an RF remote control. This robot can be built very quickly in a small budget. The RF remote control provides the advantage of a good controlling

range (up to 100 metres with proper antennae) besides being unidirectional.

4. Feasible application area study for linear laser cutting in paper making processes By A. Happonen, A. Stepanov, H. Piili

Traditional industry sectors, like paper making industry, tend to stay within well-known technology rather than going forward towards promising, but still quite new technical solutions and applications. This study analyses the feasibility of the laser cutting in large-scale industrial paper making processes. Aim was to reveal development and process related challenges and improvement potential in paper making processes by utilizing laser technology.

This study has been carried out, because there still seems to be only few large-scale industrial laser processing applications in paper converting processes worldwide, even in the beginning of 2010´s. Because of this, the small scale use of lasers in paper material manufacturing industry is related to a shortage of well-known and widely available published research articles and published measurement data (e.g. actual achieved cut speeds with high quality cut edges, set-up times and so on). It was concluded that laser cutting has strong potential in industrial applications for paper making industries. This potential includes quality improvements and a competitive advantage for paper machine manufacturers and industry. The innovations have also added potential, when developing new paper products. An example of these kinds of products are ones with printed intelligence, which could be a new business opportunity for the paper industries all around the world.

5. Implementation of tactile sensors on a 3-Fingers Robotiq®adaptive gripper and visualization in VR using Arduino controller by Luigi Pellicciaa, Marco Schumanna, Manuel Dudcziga, Michele Lamonacab, Philipp Klimanta, Giuseppe Di Gironimo

Tactile sensors are essential components for the implementation of complex manipulation tasks using robot grippers, allowing to directly control the grasping force according to the object properties. Virtual Reality represents an effective tool capable of visualizing complex systems in full details and with a high level of interactivity. After the implementation of cost-effective tactile arrays on a 3-finger Robotic gripper using an ARDUINO controller, it is presented an innovative VR interface capable of visualizing the pressure values at the fingertips in a 3D environment, providing an effective tool aimed at supporting the programming and the visualization of the gripper VR.

3. PROBLEM STATEMENT

- Replacement of pick and place end effectors of Cartesian co-ordinates system into a laser cutting machine by utilizing reverse engineering.
- To provide robot as a study material for engineering colleges at lowest possible cost

4. METHODOLOGY

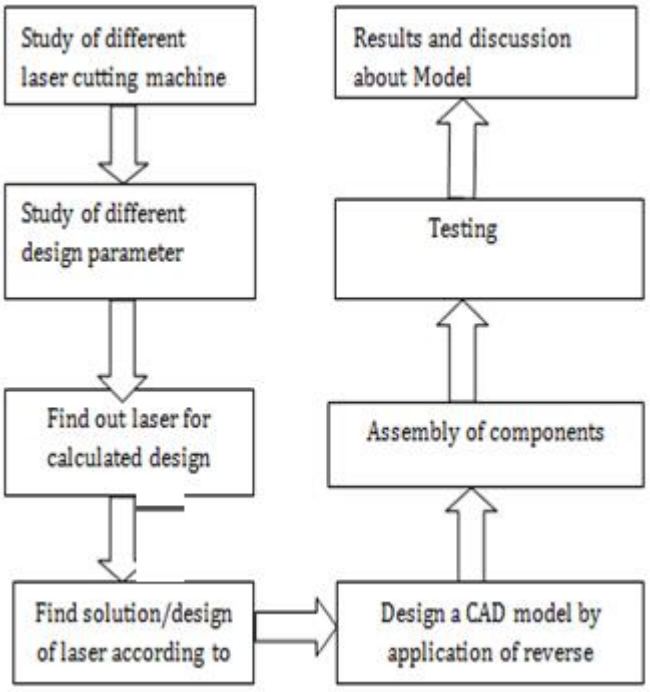

Chart-1: Rough model

5. DESIGNING OF LASER CUTTING MACHINE

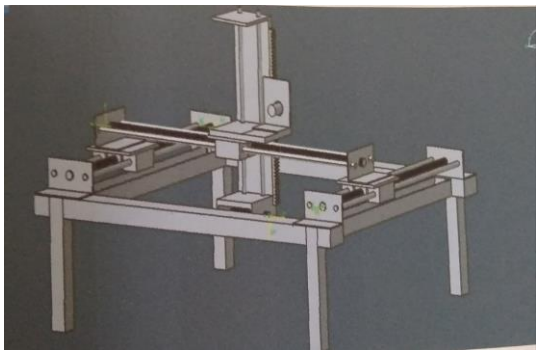

Fig-1: Assembly in CATIA

The measuring of all dimensions and converting of existing model into CAD model was done by using CATIA V5R20. The separate part drawing of various components has been done and by using this part assembly is created.

6. MANUFACTURING AND ASSEMBLY:

As the main objective of project is to make the model at lowest cost and provide for study purpose the mild steel is selected as fabrication material which is relatively low in cost. After cutting the material by cutters the machining process like turning, drilling, grinding is done on that material. After cutting and machining operation assembly is done with the help of screws, nut, bolts etc.

Fig-2: Part assembly

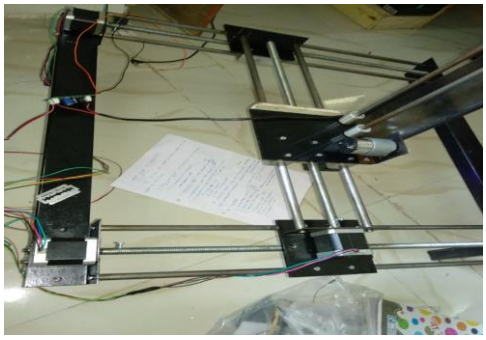

Fig-3: Final Assembly

7. REQUIRED SOFTWARES AND HARDWARE

7.1 SPECIFICTION OF LASER USED

1. Wavelength:405NM
2. Power:500MW
3. Electric current:<2A
4. Input voltage: DC/AC 12V
5. Working temperature:- -10~+40 degree c
6. Size:33*33*65 mm
7. Cable length:40 cm
8. Features: Laser adjustable feature

The software required to run this project are:

1) java 2) arduino uno 3) Inkscape 4) Universal G code sender 5) grbl

1)Arduino uno 1.8.5:- The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

2)Inkscape: Inkscape is a free and open-source vector graphics editor; it can be used to create or edit vector graphics such as illustrations, diagrams, line arts, charts, logos and complex paintings. Inkscape's primary vector graphics format is Scalable Vector Graphics (SVG), however many other formats can be imported and exported. Inkscape can render primitive vector shapes (e.g. rectangles, ellipses, polygons, arcs, spirals, stars and 3D boxes) and text. These objects may be filled with solid colors, patterns, radial or linear color gradients and their borders may be stroked, both with adjustable transparency. Embedding and optional tracing of raster graphics is also supported, enabling the editor to create vector graphics from photos and other raster sources. Created shapes can be further manipulated with transformations, such as moving, rotating, scaling and skewing

3) Universal G code sender: Universal G code sender is used to generate the g code. To define the path for laser tool it is necessary to generate the g code defined sketch. This is done by universal g code sender. After generating the g code file, UGS sends g code file to grbl.

4)grbl controller: Grbl Controller is software that is designed to send GCode (which is come from universal g code sender) to CNC shield

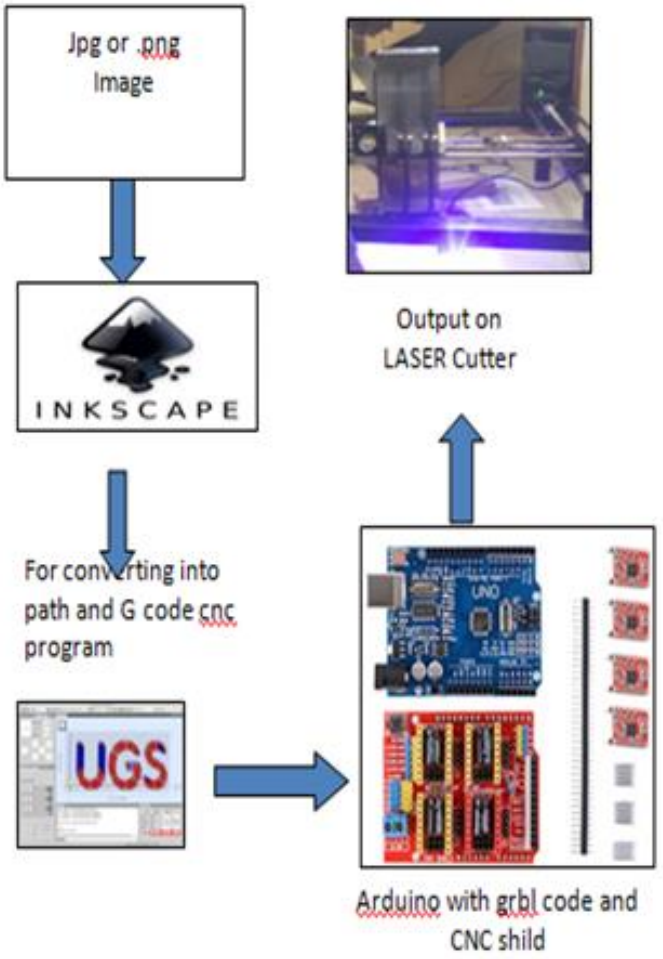

Fig: 4 Flow Chart for Output

8. TESTING

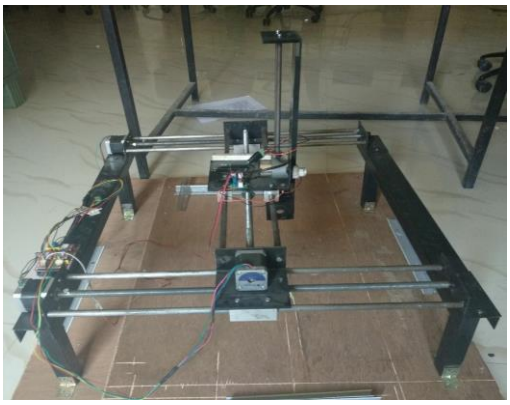

Fig-5: Final Assembly and testing

By using the arduino software laser tool power tested for different non metals for different thickness, feed, speed etc.

9. CONCLUSION

With the help of reverse engineering the Cartesian coordinate system is successfully converted into laser cutting machine. It is concluded that the laser cutting machine is working properly and able to cut the non metals with good accuracy.

REFERENCES

[1] D. Stewart, 1965,"A platform with 6 degrees of freedom", Proc.of the Institution of mechanical engineers, Vol. 180 (Part 1, 15),pp. 371-386, 1965.

[2] Clavel, R. 1986. Une nouvelle structure de manipulation parallèle pour la robotique légère.R.A.I.R.O. APII, Vol 23, No6.

[3] Griffis, M., and Duffy, J.,"A Forward Displacement Analysis of a Class of Stewart Platforms," Trans. ASME Journal of Mechanisms, Transmissions, and A automation in Design, Vol. 6, No. 6, June 1989, pp. 703-720.

[4] Zhang, D. Parallel Robotic Machine Tools. Oshawa: Springer Science and Business Media, LLC 2010, ISBN 978-1-4419- 1116-2, e-ISBN 978-1-4419-1117-9

[5] Kumstel, J. and Kirsch, B., 2013. Polishing titanium- and nickel-based alloys using cw-laser radiation. Lasers in Manufacturing (LIM 2013), 41, pp. 355-364.

[6] Perry, T.L., Werschmoeller, D., Duffie, N.A., Li, X.C., and Pfefferkorn, F.E., 2009. Examination of selective pulsed laser micropolishing on microfabricated nickel samples using spatial frequency Analysis. Journal of Manufacturing Science and Engineering - Transactions of the ASME, 131(2).

[7] Temmler, A., Willenborg, E., and Wissenbach, K., 2011. Design surfaces by laser remelting. Lasers in Manufacturing 2011: Proceedings of the Sixth International Wlt Conference on Lasers in Manufacturing, Vol 12, Pt A, 12, pp. 419-430.