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DESIGN & FABRICATION OF A WALL PRINTER

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ABSTRACT

Interior designs and mural paintings which are common in overseas and in India are done to increase the aesthetic beauty of interior walls of offices/, house buildings. It is made accomplished by conventional and newer technique. One of the new technology that is used by interior designers is wall printing or direct to wall printing technology. But it is not common due to its unaffordable price and uneasiness in availability. Our project aims at the fabrication of wall printer which is affordable.

Fabrication is done using simple and cost effective techniques like using cheap engineering materials, raw materials. Nema motors are used as the stepper motors. Chain drive and belt drive are used for the sake of simplicity. Adruino program is selected to perform the printing action since it is economically available software. The main objective of the project is to make simple and cost effective wall printer comparing with the existing models.

Keywords: Wall printer, CNC control, Robotic arm, Plotter.

I.INTRODUCTION

Wall printing is the process of printing something directly on a wall, ceiling, or other large permanent surface. Wall printers and printing is common in Australia , China and in Europe. There are many different ways to enhance the interior aesthetic beauty of our home or office and a variety of wallpaper and custom wall decals available online . These are all common ways to give drab decor a much needed lift . The prototype can print directly to our wall to create custom murals that reflect customers imagination for truly unique finish that can transform any space in an instant. Using state of art wall printing technology, we are able to produce custom wall printings for kids and adults alike. Be it a logo, advertisement or decorative touches in our home office, the product can help to make a lasting impression quickly and efficiently. Like traditional printing, the printer attaches to a laptop.it just happens to be bigger than most and amazingly prints 'vertically'. Being able to print directly onto vertical surfaces creates all kinds of new wall decoration options. Customers wall is the canvas, so images are no longer constrained by a frame. No more holes in walls from hanging pictures, no children will be able to rip off these prints like wall stickers and if it is decided to refresh the wall – just paint over it to return it to new. The oldest automated printing methods are still in use today. Surface machines lay down very heavy amounts of ink. The ink "creeps" when it hits the paper, so the images are not as crisp as the other methods. Also, there is no drying between color stations. Because of the heavy lay down of ink, and the inexact image rendering, surface printing has a very distinct look. It is

especially well suited for multi-colored floral patterns and classic document designs. Surface printers can usually print up to 12 colors.

II. OBJECTIVE

The main problem for interior designers and those who desires to design walls of residents, offices, hotels etc. is the selection of a talented muralist. Talented muralists and painters who can express the imagination of sponsor is commissioned with reasonable payments. Even though unmatched aesthetic designs are created on walls the period of completion is not acceptable now days. Wall printer is a novel concept for this problem. It is a mechatronics product which develop mural paintings or designs directly on walls with fraction of time consumed by muralist. Available products have a disadvantage that it costs 6 to 15 lakhs of rupees and will take 15-25 days minimum for delivery in India and our local markets. The fabricated product is an answer for above problems. It will cost only 10 percentage of available product. It is a combination of mechanical and electronic components run with 'Arduino' software guided by 'pics art' application. Our concept aims at printing of simple designs with one color . It is by inputting desired design, converting it into CNC codes, running the 'Arduino program' for calibrated axes . Common man having computer knowledge is able to operate the machine. As a whole wall printer is reducing the difficulties in designing and using in an economical way.

III.EXPERIMENTAL / ANALYTICAL PROCEDURES

COMPONENTS SELECTED

The major components that are effectively involved in the Fabrication of the Wall Printer are as follows.

1. Nema 34 stepper motor for Y axis.
2. Nema 24 stepper motor for X axis.
3. Linear accelerator.
4. Timing chain and sprocket.
5. Timing belt and pulley
6. Multi wood.
7. Arduino Mega
8. H bridge
9. Controller and Industrial power supply
10. Multi-color wire
11. GI square and rectangular pipes.
12. Aluminum Extrusions
13. Self-screws and Nut-bolt

DESIGN CONCEPT

CAD/CAE

Computer aided design or CAD has very broad meaning and can be defined as the use of computers in creation, modification, analysis and optimization of a design. CAE (Computer Aided Engineering) is referred to computers in engineering analysis like stress/strain, heat transfer, and flow analysis. CAD/CAE is said to have more potential to radically increase productivity than any development since electricity. CAD/CAE builds quality form concept to final product. Instead of bringing in quality control during the final inspection it helps to develop a process in which quality is there through the life cycle of the product. CAD/CAE can eliminate the need for prototypes. But it required prototypes can be used to confirm rather predict performance and other characteristics. CAD/CAE is employed in numerous industries like manufacturing, automotive, aerospace, casting, molding making, plastic, electronics and other general-purpose industries. CAD/CAE systems can be broadly divided into low end, mid end and high-end systems. Low-end systems are those systems which do only 2D modeling and with only little 3D modeling capabilities. According to industry static's 70-80% of all mechanical designers still uses 2D CAD applications. This may be mainly due to the high cost of high-end systems and a lack of expertise. Mid-end systems are actually similar high-end systems with all their design capabilities with the difference that they are offered at much lower prices. 3D sold modeling on the PC is burgeoning because of many reasons like affordable and powerful hardware, strong sound software that offers windows case of use shortened design and production cycles and smooth integration with downstream application. More and more designers and engineers are shifting to mid end system. High-end CAD/CAE software's are for the complete modeling, analysis and manufacturing of products. High-end systems can be visualized as the brain of concurrent engineering. The design and development of products, which took years in the past to complete, is now made in days with the help of high-end CAD/CAE systems and concurrent engineering

MODELLING

Model is a Representation of an object, a system, or an idea in some form other than that of the entity itself. Modeling is the process of producing a model; a model is a representation of the construction and working of some system of interest. A model is similar to but simpler than the system it represents. One purpose of a model is to enable the analyst to predict the effect of changes to the system. On the one hand, a model should be a close approximation to the real system and incorporate most of its salient features. On the other hand, it should not be so complex that it is impossible to understand and experiment with it. A good model is a judicious tradeoff between realism and simplicity. Simulation practitioners recommend increasing the complexity of a model iteratively. An important issue in modeling is model validity. Model validation techniques include simulating the model under known input conditions and comparing model output with system output.

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Generally, a model intended for a simulation study is a mathematical model developed with the help of simulation software.

Software for modeling:

- Solid works,
- Creo,
- CATIA,
- Unigraphics, etc.

ENGINEERING DESIGN (SOLID WORKS)

CATIA offers a range of tools to enable the generation of a complete digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry of other integrated design disciplines such as industrial and standard pipe work and complete wiring definitions. Tools are also available to support collaborative development.

A number of concept design tools that provide up-front Industrial Design concepts can then be used in the downstream process of engineering the product. These range from conceptual Industrial design sketches, reverse engineering with point cloud data and comprehensive free-form surface tools.

The figures represent CAD model in CATIA.

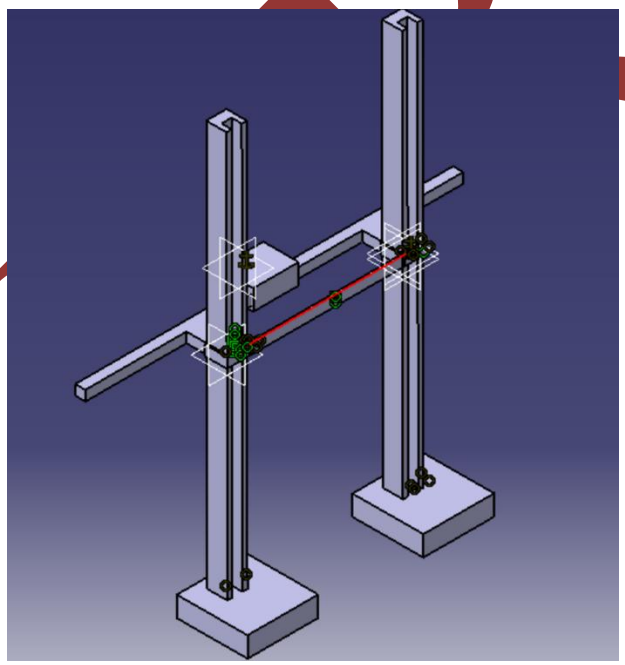

Fig. 1. Cad design

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IV. DESIGN CALCULATIONS

At first, printing frame was fixed with reference to wall printer model YICONG available online. Dimensions of printing frame was fixed as follows.

Width = 100 cm
Height = 104 cm

Printing area of 100 square centimeter was developed, with 2 cm clearance above and below for bolting aluminum extrusions .Dimensions of main frame was fixed as;

Width = 110 cm
Height = 280cm

Printing positions may vary, so adjustable brackets are used to fix the printing frame on main frame so that height be varied. Printing are and dimensions vary among products. A source comes from ' Opticure Solutions ' which an ISO 9001:2008 certified company has its standard dimensions as 120(W)x250(H), where customized dimensions are also available.

While constructing frame moment acting on it when X axis of the printing frame should calculate, so that counter weights fixed in the cabin can avoid the bending of the frame. Equivalent moment is calculated as ;

Equivalent resultant couple moment = 35x2.4 = 82.4 N-m

Counter weight that should place;

82.4 = Wx1.1x9.81

= 8 Kg

Bearing are fixed for carrying loads of Print head, chain, motors etc. Load required to carry by the bearing is estimated and RS 651 bearing is calculated. Specifications of RS 651 is;

Dynamic load = 1.11KN
Static load = 190 N

Weight of printing frame is estimated. It is found to be 13.5 Kg including chain drive & sprockets. Stepper motors 34& 23 is selected having power;

P=1.23KW (Nema 23)
P=1.875KW (Nema 34)

Nema 23(X axis)

Weight = 0.45kg
Torque = 1.31 to 2.4 N-m
Speed = 9000rpm
Step Angle = 1.8°
Rotor MI = 0.48 kg/cm²
Ambient Temperature = -40 to 85°c
P = 1.23 KW

Nema 34 (y Axis)

Weight = 2.1kg
Torque = 1.99 N-m
Step Angle = 1.2°
Rotor MI = 1.2 kg/cm²
Ambient Temperature = -10 to 50°c
P = 1.875 KW

Bearing Specification

Cylindrical roller bearing
Outer diameter =16mm
Inner Diameter = 5mm
C_0 = Fo x i x Z x le x D cos α
I= number of rows
Z= number of balls
α= Nominal angle of contact
Fo= 21.6
I=1
z=11
Ie =0.1mm
Co =21.6 x 1 x 11 x 0.1 x 16 x cos 15 = 0.38 KN

Equivalent Static Loading

WoR =Wa
Wr =Radial Load
Wa =Thrust load
WoR =0.5 x 380 =190 N

Dynamic Loading

Fc = 5.95
C =1.11 KN

Equivalent Dynamic Load

W = X x V x Wr + Y x Wa

W=1 x 1 x 1111 = 1.11 KN

Frame Specification

Main Frame = GI Square
Printing Frame = AI extrusion
Base = GI rectangle
cabin = Multi-wood
cabin Frame = GI Square

Weight

Main Frame = 8.8 Kg
Printing Frame = 13.36 Kg
Base = 6.75 Kg
cabin = 4 Kg
Total Weight = 40 Kg

Chain Drive

Chain drive requires only linear movement and more power transmission. There is no slip in chain drive. Chain drive gives only less load on sprockets.

Belt Drive

We use Belt Drive for precise and high speed application in X axis. They run smoothly and with little noise, and cushion motor and bearings against load changes, albeit with less strength than gears or chains.

V. RESULTS AND DISCUSSION

RESULTS

To create wall printer, the components of wall printer and desk jet printers that will be used has been identified to suite the design . It has been done with unused components of printers and scrap materials.

VI. FABRICATION DETAILS

Fig. 5. Figures of Fabrication

DETAILS OF FABRICATION

Used stepper motors are purchased to reduce the cost of product. Stepper motors are tested with electric power supply. It is done with power supplies such as mobile charger, as direct AC from power supply can damage the motors permanently. Stepper motors are small in size and easy to handle able

to carry various loads according to their specification.Fabrication of frame is done with GI pipes which is easily available in the market. Y axis is fabricated with timing chain of motorcycle and its sprockets. Electronic components are connected with motors using multicolor wire with stepper motors in X and Y axis and with linear accelerator.

In the other side by using used and scrap items for fabrication has been reducing the cost of making the project which the price of the components was sold in low price. In market view, we can just be selling this product cheaper in market place compared to other wall printers that already established in the market.Besidesthat, it is possible to recycle the broken components instead of components become waste. The prototype looks like a steel frame which is larger in size. But easily assembled and disassembled. Electronic components are placed inside the box which made as a laptop stand and it enhances the aesthetic beauty of the product. The wall printer has been equipped with wheels which make it easier to move rather than that to lift it up. The weight of the wall printer also has been reduced due to use of hollow pipes and aluminum extrusions comparing with existing products, which is light in weight and strong. Beside this it has been designed with plug and on concept which we just needed to plug the power source and connect PC on this system. Other than that, there are just a few steps to assemble the system. The printer can be assembled faster than the existing products also.

VII. CONCLUSION

As a conclusion, we can conclude that a cheap wall printer is achievable and can be marketed in reality. The wall printer that we fabricated satisfies the basic wall printing functions. With the fabrication of wall printer problems faced by interior designers in designing interiors with murals and wall decals will reduce. Using state of art wall printing technology, we are able to produce custom wall printings for kids and adults alike. Be it a logo, advertisement or decorative touches in our home, office. Our product can help to make a lasting impression quickly and efficiently. With its common design it makes a similarity with existing products, making it not unappealing. We can print directly to your wall to create custom murals that reflect your imagination for a truly unique finish that can transform any space in an instant. The cost of available product is not affordable by all, but our product is an answer to it. Cost of production limited to Rs.30000 for single color, and can make in bulk units with multicolor printing at a maximum rate of Rs. 40000.This can make a big change in interior design field. The wall printer is also proved that it is easier to move the machine with wheels and fix it by easy assembling and disassembling. It could make user faster to move and setup the printer.

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