Design and Development of low cost CNC 3- axis vacuum gripper Material Handling Equipment

Anjana.S.Balehosur[1] A.K Murthy[2]

[1] *Research student, East Point College of Engineering and technology Bangalore, 560054, India.*

[2] *Professor and Head, Dept. of Mechanical Engineering, East Point College of Engineering and Technology, Bangalore, 560054, India.*

[1]*Anjana.sb007@gmail.com*

***Abstract*— Increment in the fast development of Technologyfundamentally expanded the use and usage of CNC frameworks in businesses however at impressive costly. The CNC (Computer Numerical Control) is an innovation which expects to produce, parse and execute consecutive activities in Material Handling by reducing manufacturing cycle time, delays, damages and promote safety and improve working conditions. The taught on creation of ease CNC Material Handling equipment to decrease the expense by using elements of standard PC interface with open source Arduino uno frame work. The paper talks about 3-axis Handling operation done easily by simple G-Code parser on the small scale controller from a USB. Programing created in Gbrl controller and set up a correspondence between machine and the PC. The Handling of materials done with help of Air compressor which creates vacuum and suction cup helps in picking and placing.**

***Keywords*— Computer numerical control, material handling, Arduino uno, Gbrl**.

I. INTROD CTION

The present day industry in the field of manufacturing has been highly flexible due to the specialization in the use of CNC system, which stands for Computer Numerical Control and also the use of robotics. Material handling system which helps in moving, putting away the material, protecting and also controlling of the materials. Increment in the rapid development of the Technology essentially. Expanded the use and usage of CNC structures. This work talks about improvement of an insignificant effort CNC material taking care of equipment which is introduced to operate in three axis and the lower cost or expenses accomplished by fusing the elements of standard PC interface with littler scale controller based CNC frame working an Arduino based installed frame work. The edge work additionally includes a logged off G code parser and after that a translated on the smaller scale controller form USB. Enhanced strategies are utilized in the structure while keeping away from any misfortune in general framework execution.[3]

The low cost is achieved by CNC operation and works with an open source hardware which is called Arduino, an embedded system and hence it is a low-cost material handling equipment. The programs produce a computer file that is interpreted to extract the commands needed to operate a particular machine. This open source will help us in the execution of the G codes as well as the M codes.The main idea of this project is to make all small scale industries also to use the low cost material handling equipmentp which consists of system moving in all the three direction, namely x-axis, y-axis, z-axis. The arduino is an open source in which the programming which we use is coded along with the software, and is executed using M codes and G codes.

The use of CNC operations not only reduces the cost but the results or work is done within no time i.e, it helps to do the work quicker and faster. And the results achieved are exact and the error caused is negligible or no error compared to manual operating. The vast advantages behind the Arduino and interface of CNC is the reason behind choosing this project work, so that the material handling can be widely used and easily available even in small scale industries and it also enhances the profit.

II. LITERATURE REVIEW

Dr. B. Jayachandraiah *et al.*(2014) They investigated the idea of fabrication using low cost CNC routers to fulfill the necessity from small scale industries to large scale industries with modified low cost. A new development in the computer

technology is the availability of the low-cost open source, such as Arduino microcontroller. By using this open source the machine can be operated through the G codes & M codes,so it is a low cost & has high exactness and reliable.One can use this open source to execute various kindof machines with the help of G codes and M codes.It is an advantage of the open hardware source so that a variety of ready-to-use software is also available on toWeb, there after the prototyping and also a vast development time is reduced Using this knowledge they developed a prototype 3-axis CNC Router using the Arduino based controlling system of low cost, which is easy to operate,very flexible and minimum power consumption.[1]

Manjunatha C J *et al.* (2015) They designed a CNC which depicts Computer Numerical Control isused for milling purpose. For running simple designs & large production other produced by other method and CNC can be although used for a wide range of production, manufacturing needs. The CNC milling centres although a solution for every ranging from short-run production to prototyping of difficult parts which are complicated to fabrication. In this work they have achieved a low-cost, desktop 3-axis vertical CNC milling developed for student purpose in order to perform CAD/CAM and CNC programming. Basically it is low cost as it uses an open source Arduino amicrocontroller for controlling of motors and the same source used for execution of G & M codes for machining applications[3]

III. EXPERIMENTAL SET UP

Machine structure is the "spine" of the machine device. It incorporates all machine parts into a complete framework. The machine structure is significant to the execution of the machine instruments since it is specifically influencing the static and element solidness, and in addition the damping reaction of the machine apparatus. A well outlined structure can give high firmness, result in higher operation, handling speed and more exact operation. A little scale machine instrument for the most part requires considerably higher solidness than the conventional substantial scale machine device since it is typically worked in all environmental conditions and is portable. Since it is portable there is need to use compact structures which gives high efficiency. The model is designed with three axis, where the X-axis is pivoted on the screw rod with two supporting guide rods and the stepper motor fixed with the help of stepper motor coupling on the screw rod. Y-axis is pivoted on the base with the support structure similar to the X-axis, and Z-axis is pivoted on the X-axis which has the material handling components fixed on it. It is an open case structure with a support leg made up of A36 material to withstand all force and is a robust one.[1]

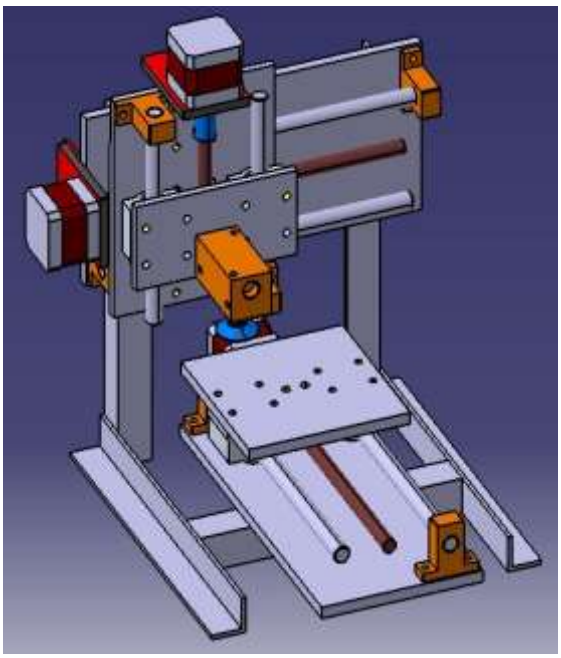

Fig.1 CATIA V5 model

A. Mechanical systems

The major part of the Vacuum based CNC operated Material Handling system consists of Mechanical system. The Mechanical system consists of the following assembly components.

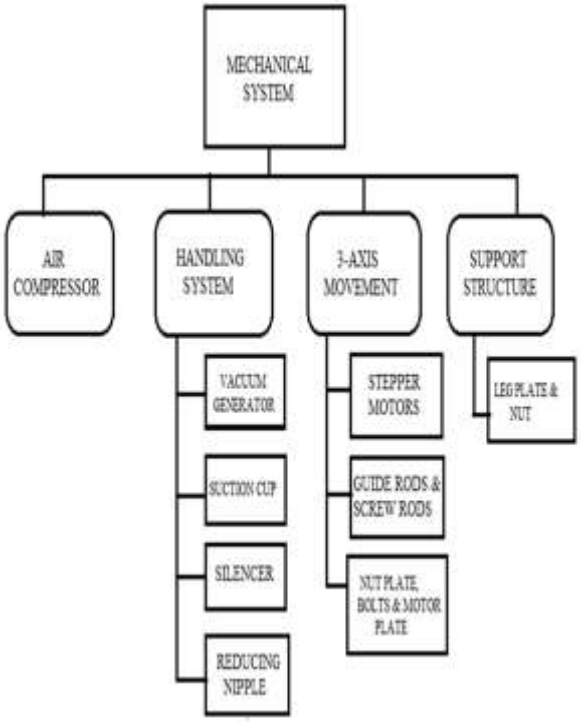

Fig. 2 Components of Mechanical system.

Fig. 3 Linear Motion end support

The fig. 2 demonstrates every one of the segments required in the fabrication of the material taking care of gear. Be that as it may, these are just the mechanical segments.

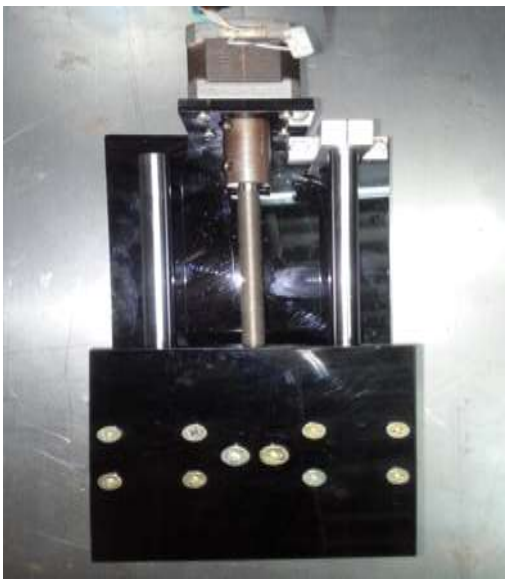

Fig. 5 Components for each drive

The components shown in fig. 3 is a linear motion end support which are used to fix the guide rods at the end. The component in fig 3 is a slide bearing pivoted for the guide rods motion.

The fig 5 is a complete part for each drives. There are 3 drives X-axis, Y-axis and Z-axis. Each of consists two guide rods and two LM end support and a screw rod mounted to a stepper motor with a bush. Screw rod helps in the movement of the axis. So the fig.5 is complete picture of each of the driver part.

Fig. 6 VAD ¼ generator

The fig. 6 demonstrates a VAD ¼ generator which can produce 1.5 to 10 bar weight. There is a suction glass joined to it with a reducing nipple.

Fig. 7 VAS-75-1/4 –PUR-B suction cup

The fig. 7 demonstrates a suction glass which makes a vacuum with help of vacuum generator. Furthermore, it helps in pick and place of materials. It is a level suction glass with distance across 30mm

Fig. 8 Air compressor

The air compressor shown above is a DC 12-13.5 V with max pressure 150 PSI and 15 amps. It is connected to a vacuum generator and the battery.

The battery is connected to air compressor which is a re-chargeable sealed lead-acid generates 12V, 7.5Ah @ 20 hrs.

B. Electronic system

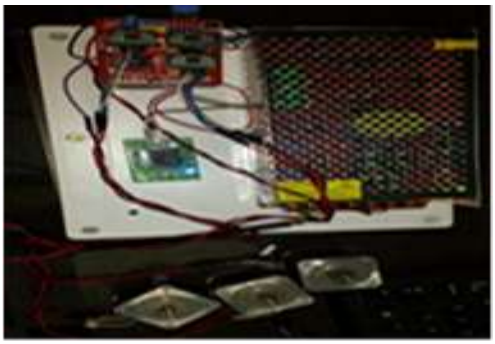

Fig. 9 Electronic circuit

The electronic consists of arduino uno and cnc shield shown in fig. 10, these are main components of ciruit. The arduino uno is placed beneath the cnc shield. The shield has three drivers placed on it. These are X-axis, Y-axis and Z-axis drivers. Each driver is further connected to each stepper motor respectively. Stepper motor used here is NEMA-17.

The adopter is placed into the circuit board which is a power supply to the drivers. It is about 5V which helps for the dis

Fig. 10 CNC shield

placement of the three axis. The relay board has intermediate connections from cnc shield, a compressor, a battery and ground-ground connection between shield. The connection from cnc is made between a 12 V supply on relay. There is a a connection from adopter to the relay board. Which has a supply of 12 volts.

Fig. 11 Arduino uno chip

Arduino is a well-known programmable board used to make ventures. It comprises of a basic equipment stage and also a free source code editorial manager which has a "single tick accumulate or transfer" highlight. Subsequently it is outlined in way that one can utilize it without fundamentally being a specialist software engineer. Arduino offers an open-source electronic prototyping stage that is anything but difficult to utilize and adaptable for both the product and equipment. Arduino can sense nature through accepting contribution from a few sensors.

It is additionally ready to control its encompassing through controlling engines, lights and different actuators.

IV. RESULTS AND DISCUSSION

The demonstrated figure 12 portrays the complete amassed model, which is currently prepared to work in all the three hub. The fig 4 gives the photo of a y-hub. So also other two hub specifically X-hub and Z-pivot is collected with screw pole, two aide bars, LM end bolsters, one slide bearing and one stepper engine.. The Z-pivot is mounted on X-hub, and both are playing out their capacity.

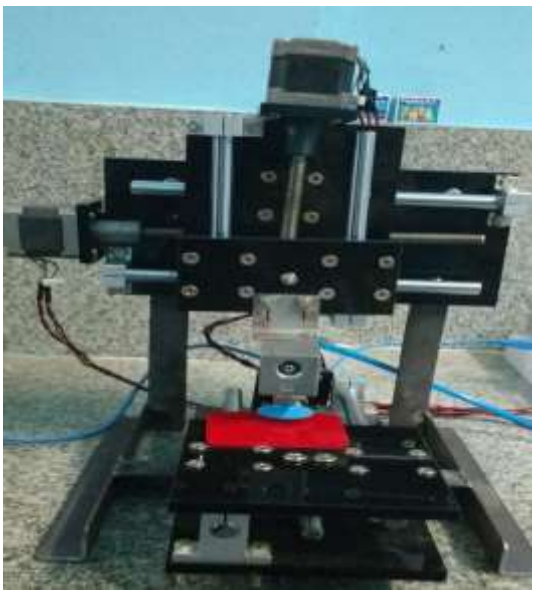

Fig. 12 Fabricated model

The bolster structure is comprised of mellow steel and subsequently it can hold up under the heap connected and is vigorous. It is outlined in a manner that it is versatile and effectively worked.

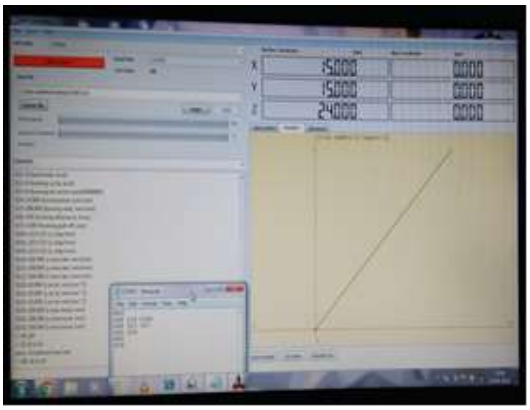

Fig. 13 Grbl controller

Fig 10 demonstrates the interface programming utilized as a part of the procedure i.e, grbl controller. The G and M codes utilized as a part of the procedure are straightforward just to pick and place the article. Here G01 is utilized to give movement, M03 is utilized to produce vacuum, F100 is a case for giving food rate at 100 rpm, M05 is to prevent the suction container from creating vacuum, M30 is to stop the system. This vacuum Material Handling gear is anything but difficult to utilize and straightforward, so it can be utilized generally.

The fig 14 exhibits the last and over all course of air conditioning action made and its working. The USB is connected with the PC and it goes about as an interfacing unit. There is a battery connected with the air compressor making 12V to deliver vacuum and it helps the suction glass to hold the things.

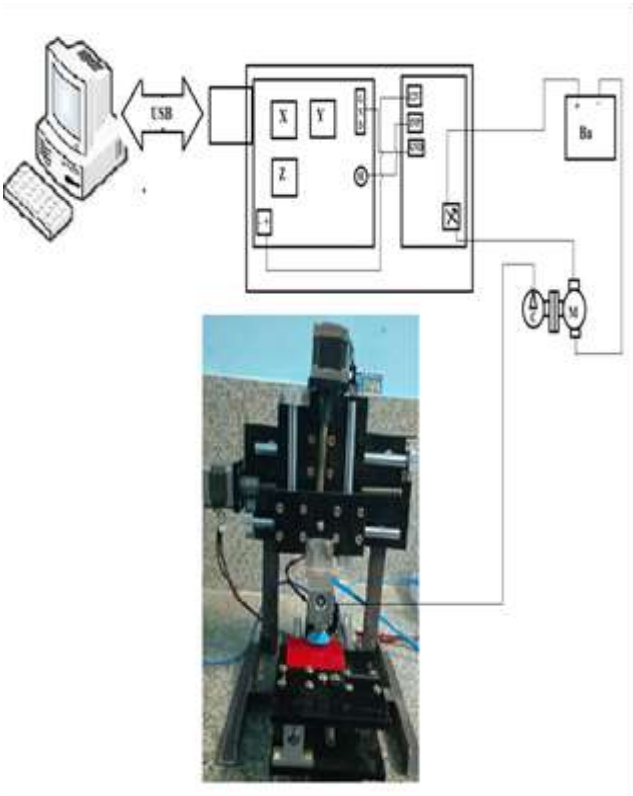

Fig. 14 Overall process of the working

This model is expected to pass on 6Kg force. furthermore, the points of interest of parts used are given as a part of the underneath table. The model can be scaled in size to pass on overpowering things by adding all the more support to the

structure and using a vivacious base. The model works in all the 3-center and as indicated by the CNC program given. It takes after heading and generally the grbl controller has more responsibility.

TABLE I
SPECIFICATIONS OF THE COMPONENTS

X axis travel	120mm
Y axis travel	120mm
Z axis travel	120mm
Stepper motors	NEMA-17, Revolution 200, shaft load 20,000 hours at 1000 RPM
Lead screws and Guide rods	Screw is A36 material and Guide rod is C45 material
Vacuum gripper	Round flat, diameter 30mm, nominal size 3mm, operating pressure -0.9 to 0 bar
Vacuum generator	VAD ¼ , operating pressure 1.5 to 10 bar.
Power supply	24 V, 15A, 360 W, switching power supply
Microcontroller	Arduino Uno, with ATmega328P @ 16MHz
Air compressor	12V air compressor

V. CONCLUSIONS

With the expanding interest for little scale high accuracy parts in different businesses, the business sector for little scale machine devices has become susbtantially. Utilizing little machine apparatuses to create little scale parts can give both adaptability and effectiveness in assembling approaches and decrease capital cost, which is gainful for little entrepreneurs. In this postulation, a little CNC 3-axis vacuum gripper material handling equipment is composed and examined and restricted amount of weight handled. Further for large scale or MNCs the heavy objects in industries.. For instructional purposes and also for more exact operation, it is desirable over form CNC machines with DC or AC servomotors and encoder input utilizing PC-based movement controllers.

FUTURE WORK

It is wanted to scale up the model CNC machine as far as size, utilize all the more effective vacuum generators and high capacity air compressor, reinforce the casing and worktable with materials like aluminum or cast iron, and increase the CNC control programming with programming for handling oh

ACKNOWLEDGEMENT

The authors would like to thank Principal, Management and non-teaching staff, Dept of Mechanical Engg EPCETBangalore, Karnataka for their encouragement, support and facilities provided during the completion of the work.

REFERENCES

[1]Dr. B. Jayachandraiah and O.Vamsi Krishna2 and P.Abdullah Khan and R.Ananda Reddy "*Fabrication of Low Cost 3-Axis Cnc Router"* International Journal of Engineering Science Invention ISSN (Online 2319 – 6734, ISSN (Print 2319 – 6726 www.ijesi.org Volume 3 Issue 6‖ June 2014 ‖ PP.01-10 www.

[2] Gautam Jodh and, Piyush Sirsat and Nagnath Kakde and Sandeep Lutade".*Design of low Cost CNC Drilling Machine"* International Journal of Engineering Research and General Science Volume 2, Issue 2, Feb-Mar 2014 ISSN 2091-2730.

[3] Manjunatha C J and Manjunath K and Suresha P "*Design & Developmentof Portable Milling Machin"*. Novateur Publications International Journal of Innovation in Engineering, Research and Technology [IJIERT ICITDCEME15 Conference Proceedings ISSN No - 2394-3696.

[4] https//en.wikipedia.org/wiki/Linear-motion_bearing

[5] https//en.wikipedia.org/wiki/CategoryLinear_motion

[6]https//learn.adafruit.com/all-about-stepper-motors/types-of-steppers

