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"Automated Printing Machine Implementation using Spare Parts"

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Abstract - *In today's world, 3D printers are only available in science fiction stories but is now a real tangible product that is used to create objects. One who wants to make a 3D printer without spending 1000's of rupees is impossible. The inspiration for this project comes from the fact that 3D printer is really innovative and revolutionary idea but along with that they are very costly. This high cost limits the imagination of the ordinary people. The high-quality 3D printers come at a range of 65,000- 1,40,000 rupees. It all starts with imagination of the object we want to create. One can create an affordable 3D printer by using equipment in their surrounding or probably at home which is the main aim of this project. The technology of 3D printing are often used to create imagination into reality, parts of the machinery of kit which aren't available within the market, prototypes of latest idea. Due to the price, this printing technology access to world is very limited but through this project there will be an increase in the access of self-made 3D printers with the unwanted scrap materials.*

In this paper along with 3D usage, we will also be using the same mechanism in order to create a sketching matching leading to the multipurpose view of a single machine with the help of an ATMEGA 328P microcontroller.

Key Words **– fiction, revolutionary, prototypes, module, scrap, multipurpose, microcontroller**.

1. INTRODUCTION

Our idea was inspired by all of the CD-ROM CNC (Computer Numerical control) machines that are seen in the industries. They've been used as drawbots, laser cutters, drill presses, but never have been one used for a 3D printer at least not a reasonably priced one for multipurpose usage. So the goal of this project is to show how to make your own 3D printer from old CD-ROMs drives and a cheap 3D printing pen. 3D printers have certainly revolutionized the world. This project shows the simple and practical construction of CNC machine wide application of converting the CNC machines into 3D printer. The cost, construction, advantages, application are shown in this project. Due to rise of new techniques, demand for Computer Numerical Control (CNC) plotter machines in daily usage areas like educational institutions etc is on a rise. Low-cost manufacture of Printed Circuit Board (PCB) has become a basic need in electronics laboratories, for electronics engineering students as PCB is needed in every basic circuit. This project will present an affordable model of 3D printers' machine which is able to draw a circuit layout on PCB or any other solid surface using simple algorithm and available components and can even make out small sized objects. At first the user needs to convert any image file (basically the thing that one has to get as final output) into G code using Grbl software and then feed it to the machine using Processing software. ATmega328P microcontroller is used as the control device for this project. Instead of the Arduino UNO board, we will be using only the Atmega 328P IC for the controlling of the stepper motors. This element will even reduce the cost of the printer.

2. LITERATURE SURVEY

In 2017, George Isaakidis, Antonis Spiropoulos [1] proposed about additive manufacturing. Additive Manufacturing (AM) is that the process of making a three-dimensional object by placing successive layers of fabric. AM engulfs a good range of production methods, like Selective Laser Sintering, Stereolithography, Multi-Jet Modelling and Fused Deposition Modelling. The term 3D printing refers to a process where an inject printer head lays binder material upon a surface covered with powder. However, this term is employed widely in colloquial for generally any AM technique.

Romero-Alva, Alvarado-Diaz, Roman-Gonzalez [2] proposed about the proper usage of material that is used for the 3D printing and which should be safe for the environment. An important part of 3D printing is to supply printable material to the printer whenever when needed, which is essentially through with the inclusion of plastic filament reels of which the foremost common is that the PLA. ABS plastic is pretended to boost awareness within the recycling of materials like plastic to avoid pollution, and by this, the famous three ecological R's that's Reduce, Reuse and Recycle are often put into practice.

In 2015 Mohamed Y. Tarnini [3] issued a paper regarding the usage of fast and cheap use of stepper motor drives. Stepper motor is employed in most applications that require

discrete movement. Most of the robotic systems, automatic camera focus, and zoom functions use stepper motors. Stepper motor drive doesn't need any sensing device to sense the shaft position and may be considered as a cheap drive compared by other drive systems. Stepper motor represents one among the simplest sorts of motor to be controlled simply and economically in most sensitive applications like the motors utilized in the microsurgical operations, printers, scanners, disk drives and plenty of other sensitive and accurate daily industrial applications.

Pranav Mehta and Vaibhav Oza [4] proposed about the working hand using Atmega. We will also try to use the same application for sketching out a picture from our multipurpose robot. The Robotic hand works on Arduino Uno micro-controller and is programmed using Arduino C. The servo motors have strings that attach them to individual fingers, thus leading to human like motion of robotic hand. The robotic hand is often designed to be more efficient and versatile than the human hand. The robotic hand could also be connected to a network and used over long distances for carrying things also.

In 2019, Nur Shazwany Zamani [5] proposed about usage of CNC mechanism for a handwriting purpose robot. The Handwriting Robot may be a very adaptable machine, intended to serve a good assortment of requirements for daily and particular graphics and writings. The Handwriting Robot is supported by the elemental support of Computer Numerical Control (CNC). This research concerns with controlling of motor driver shield for pen movement in x & y directions to the rotation of stepper motor by using an ARDUINO IDE microcontroller. The servo-motor is employed for up and down movement of the pen in z-axis. Both of Inkscape and G-Code was utilized for generation signals from the drawing to be employed by the Microcontroller.

Cheng-Tiao Hsieh [6] proposed to develop an integrated system that contains both functions of 3D printing and Laser carving in one machine. The 3D printing is predicated on the technology of the Fused Deposition Modelling. It extrudes plastic filament from a nozzle and deposits melted plastic along planned paths layer by layer until a neighbourhood is completed. Within few years, Laser technology was developed very successfully and rapidly. Its applications are widely in various fields, like medicine, science, military, and industry. Another application is utilized Laser as a tool to execute a carving task. Since its controlled by Arduino Mega, a relay is required. The energy of the Laser is low, so it can only execute a carving task instead of drilling some kind of holes.

Ahmad Adamu Galadima [7] proposed about the usage of Arduino as a learning tool. Arduino is an open-source microcontroller utilized in electronic prototyping. Arduino hardware and its components shall be checked out. Software and therefore the Environment that Arduino runs on are both checked out too. Projects prepared with Arduino are often stand-alone or they will communicate with software running on a computer. Introducing the Arduino microcontroller to numerous levels of education can help improve the interest of building/designing things. Taking under consideration all the applications, usage of Atmega 328P led to the multipurpose usage of the machine rather than actually using the Arduino.

Benetta Aranjo, Prashant Kumar Soori and Puja Talukder [8] proposed about the use of stepper motor in robotics. A stepper motor is a digital electromechanical system wherein each electrical pulse input moves the rotor by a discrete angle called the step angle and hence the name stepper. Stepper motors are used universally for various applications in industrial areas. Robotics is one amongst the areas where the utilization of the stepper motor is of utmost importance. Robotic applications require precise movements for accuracy. A stepper motor is suitable for robotic applications because its movement comprises of discrete steps. It moves by a discrete angle called the step angle in each step. Stepper motors are utilized in commercial and industrial applications due to their high reliability, low cost, high torque at low speeds, and straightforward construction that operates in almost every environment. The drive system of a stepper motor controls its movement. A flexible drive system will allow accurate control of the movement of a stepper motor in order that it is often utilized in robotic applications.

R.Hari Sudhan, M.Ganesh Kumar, A.Udhaya Prakash [9] proposed about the Atmega 328p IC. ATMEGA-328 microcontroller contains 14 input and output analog and digital pins (from these 6 pins are considered to be PWM pins), 6 analog inputs, and remaining digital inputs. Power jack cable is used to attach board with the pc. Externally battery is connected with the microcontroller for the facility supply. Atmega is an open-source microcontroller from which there's no feedback present within the microcontroller. This board consists of the I2C bus, which will be ready to transfer the info from board to the output devices. These boards are programmed over RS232 serial interface connections with Atmega Arduino microcontrollers. The operating volt ranges from 5v. The input voltage recommended for this microcontroller is from 7v and therefore the maximum of 12v. The DC input current given to the board is within the range of 40mA.

3. PROPOSED DESIGN

A. Block Diagram

The block diagram consists of the stepper motors which are interfaced with the controller through the motor drivers (L293D). Also there is the Servo motor which is been used for the z-axis movement in this project. To this servo motor, the final 3D Gun is attached that will be used for the formation of the final product. Also instead of using the 3D

Gun, we can also attach a pen in order to draw a particular diagram in two dimension.

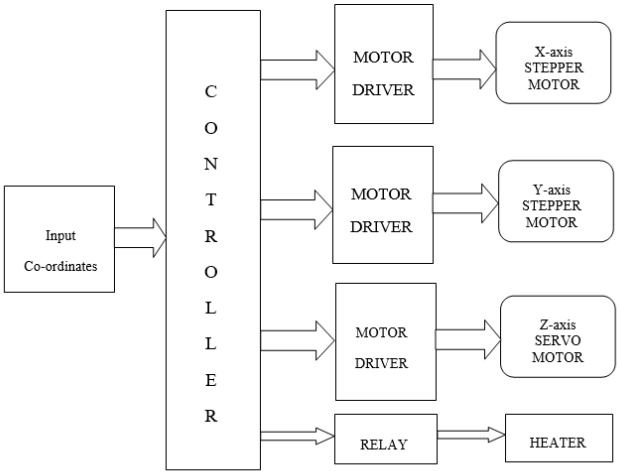

Figure -1: Block Diagram

B. Operation

The first step is to collect all the requirements for the project. The basic equipment required is stepper motor. Computer CD ROM hard drive is used for the stepper motor along with its base. Mounting Steps :

1) Mounting the motor trays: Rectangular casing are made to mount the motor trays. The motors are mount in X, Y and Z axis. First the mounting of Y-axis is done. This axis moves back and forth. A motor tray is mount on the one of the rectangular casing with the help of nuts and bolts.

Figure -2: CD Tray Mount

2) For the X-axis mount it perpendicular to the length of another rectangular casing, again making it close to one end and aligning it as straight as possible. As for the Z-axis motor itis mounted on top of the X-axis drive with the help of metallic square plate, this will provide a platform to house the Z drive. Another metallic square is placed on top of the Y drive to create a platform for printing the object.

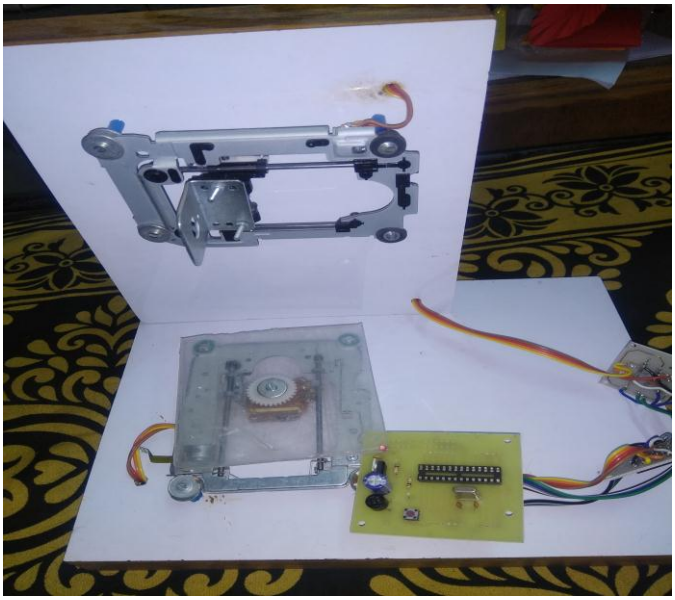

Figure -3: Mounting on wooden casing

3) Now solder all the stepper motor terminals connect these wires to the easy driver or stepper motor driver. Connect all the stepper motor drivers to the controller terminals, as per the connection given in circuit diagram. Controller is called as the 'brain' of the mechanism and the easy drivers are hand and legs of the stepper motor. Here instead of using the readily available Arduino , we will be creating our own PCB board which will consist of Atmega 328p IC and all the required elements for the controlling of motors. The usage of this self-made IC will again reduce the cost of the printer.

4) The CNC hardware connection runs on a programming language called G-Code. It essentially tells the X, Y, and Z axis to move towards the specific coordinates. For Arduino to function properly we need to install an Arduino interpreter name Grbl in the computer.

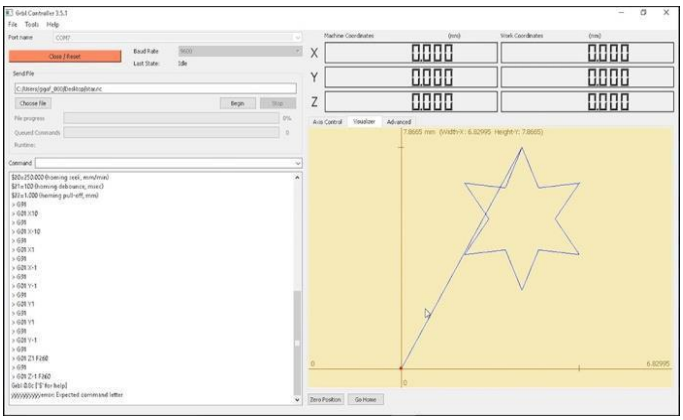

Figure-4: Grbl Controlling software

4. RESULTS

Finally, we designed a small prototype of a CNC mechanism-based 3D printer which will create small products made out of the ABS plastic material that is present in the glue gun. The overall costing of this project is very low as compared to other premium 3D printers. Here we have used the stepper motors present in the CPU CD-drives which are the unwanted scrap materials. But if one wants to create the materials on a larger scale then the stepper motors present in the Scanners or printers.

And once we change the glue gun with pen then the machine becomes a sketching or writing machine.

5. CONCLUSIONS

The previous 3D printers were studied and based on the observations made a design for a low-cost 3D printer. The schematic was made based on which prototyping will take place. The components have been chosen based on the design requirements and based on few other parameters. A timeline was made based on the review dates and work has proceeded according to it. Then according to our design, we found out some spare parts and purchased certain components required for our project to start. Since the normal 3D printers cost very high, we tried to lower the cost by using most of the E-waste present. The cost effectiveness and ease provided makes the printing technology to be very unique.

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