

**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH
TECHNOLOGY****DESIGN AND ANALYSIS OF 3D PRINTING PEN****Mr. Nayan Jyoti Gogoi^{*}, Prof. T. Jeyapoovan**M.Tech, Department Of Mechanical Engineering, Hindustan Institute of Technology and Science,
Padur, Chennai, India

Professor, Hindustan Institute of Technology and Science, Padur, Chennai, India

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ABSTRACT

In present time 3d models and prototypes helping lot of engineers and in many technical areas mainly in design field to design a real model as quickly as possible with the help of 3d printing technology. The demand for 3d printing applications are increasing day by day and it is reaching to a height of end no of applications. In this project I am going to discuss how we can make an affordable and user friendly 3d printing device which can be used as a 3d printing pen as well as a device which can be controlled by a 3d printer which will reduce the cost of a 3d printer as a whole and can be used in multipurpose activities. It will be very compact in size and user friendly and will be very cost effective. It has also capable of printing real and fully functional objects. Normal shapes can be easily handled with the 3D printing pens. The result is compared in terms of cost effectiveness and handling. The modelling and thermal analysis has been done with solidworks.

Keywords: 3D printing, 3D printing pens, additive manufacturing**INTRODUCTION**

The 3D pen is basically a handheld version of the extrusion element found in most 3-D printers with some needed heat shielding and an ergonomic grip. It is just like a hot glue gun, but shaped like very thick marker, with the ability to print a fine line of PLA or ABS. By removing the complex mechanisms in 3d printer that move the printhead, the electronics to control it, and the structure that houses it, 3d pen makes it more compact and affordable than those big bulky size 3d printers. It is compact and easy to use, the 3D pen allows you to draw in the air, whether freestyle 3D sketching or tracing shapes to make larger structures and objects. Shapes can be drawn in the air, and since the plastic cools quickly, 3-D models take shape instantly. Advanced structures can be created by drawing sub-components on flat surfaces, and then combining them into large sculptures with melted plastic. The "ink" for this pen is the same ABS (Acrylonitrile Butadiene Styrene) or PLA (polylactic acid) filament which are also used by 3D printers, but packaged into a familiar marker-style interface. This 3d printing pen will replace the extruder, the stepper motor and the heated nozzle in 3d printer and in place of that this 3d printing pen will be attached. This pen will work in two ways either it can be controlled by a 3d printer or it can also be used as a printing pen as the name suggest.

MATERIALS AND METHODS**Heated nozzle**

The 3D pen heating nozzle is the combination of heater and a nozzle. It is easily detachable just like plug and play. The heat-resistance nonmetal material keeps the working temperature at 130-200°C. It is also known as hot end. It melts the filament and allows the molten plastic to exit from the small nozzle to form a thin line of plastic that will adhere to the material it is laid on. Hot end consists of heating chamber and nozzle. The hole in the tip (nozzle) has different diameter of between 0.3 mm and 1.0 mm. Different types of nozzles and heating methods are used depending upon the material to be printed.



Figure 1. heated nozzle

Dc gear motor

It is small size 12mm geared dc motor with less rpm and large torque. This kind of small geared dc motors are used in 3d printing pens as a feeder. Since the 3d printing pen is small so a mini size dc motor is required so that it is easily fit inside the body.

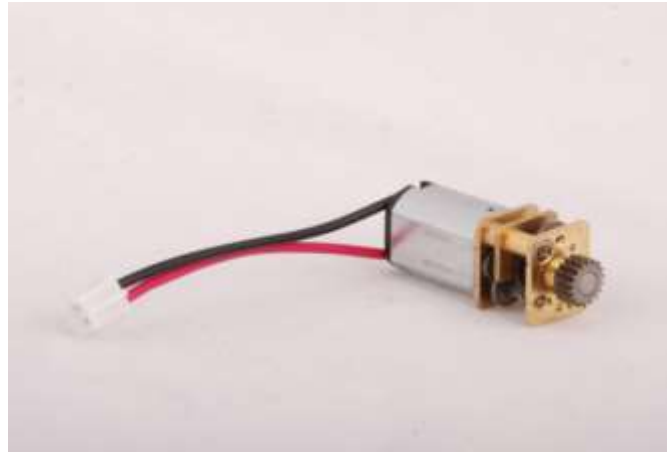


Figure 2, small dc geared motor

Mother board

Motherboard is one of the most essential parts of a electronics system. It holds together many crucial components of a computer, including the central processing unit (CPU), memory and connectors for input and output devices. The base of a motherboard consists of a very firm sheet of non-conductive material, typically some sort of rigid plastic. Thin layers of copper or aluminum foil use to trace the circuit , are printed onto this sheet. These traces are very narrow and form the circuits between the various components. In addition to circuits, a motherboard contains a number of sockets and slots to connect the other components. In this typical 3d printing pen mother board all the components are can be easily detachable and can be replaced with another one.

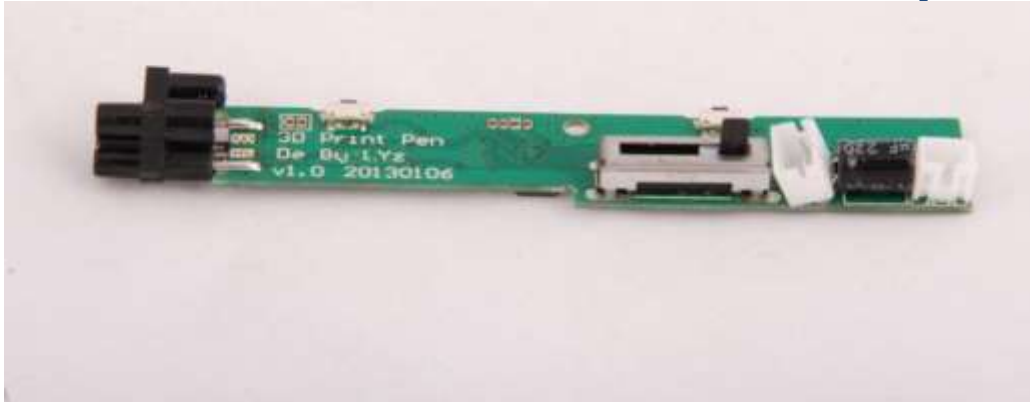


Figure 3, mother board

Pen assembly

all the above parts the dc motor , the heated nozzle can be easily assembled in the mother board here and the whole thing can be protected inside a insulating plastic cover to avoid burn while handling the pen during operation.

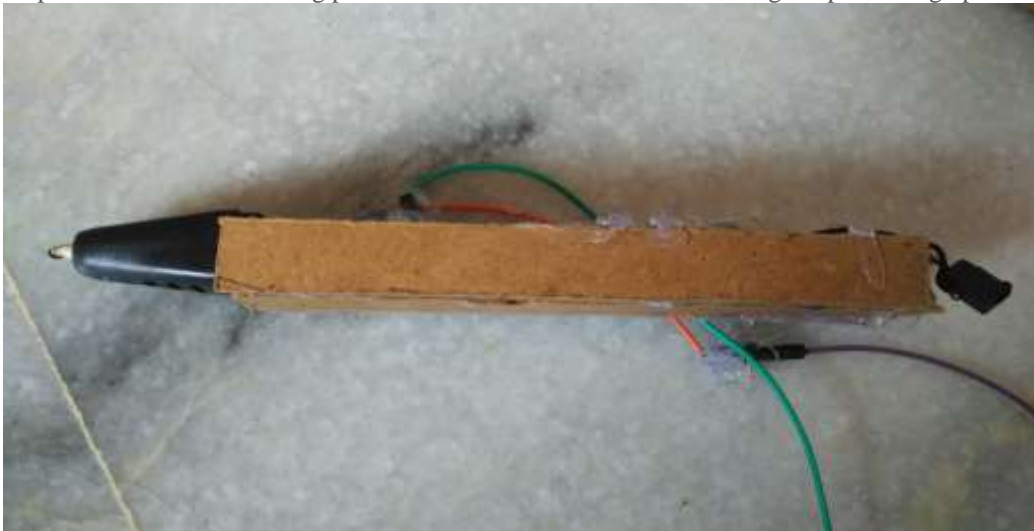


Figure 4, pen assembly

Arduino uno controller board

The Arduino Uno is a microcontroller board which is based on the ATmega328P. It has 14 digital input/output pins of which 6 pins can be used as pulse width modulation outputs, and 6 analog inputs, and a 16 MHz ceramic resonator, a USB connection, a power jack, a reset button and a ICSP header. It has everything in it to support the microcontroller. Just connect it to a computer with the help of USB cable or power it with a AC-to-DC adapter or battery to get started. It differs from all previous boards in that it does not use the FTDI USB-to-serial driver chip, instead, it features the Atmega16U2 programmed as a USB-to-serial converter.

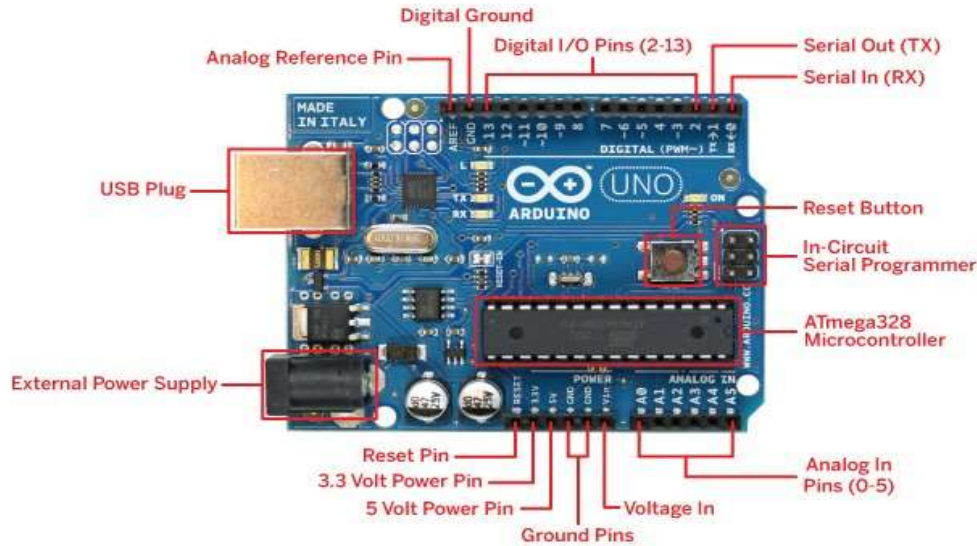


Fig 5, arduino uno

NPN transistor

A transistor is a semiconductor device which is used to amplify or switch electronic signals and electrical power. It consists of a semiconductor material with three terminals for connection to an external circuit. A voltage or current which is applied to one pair of the transistor's terminals changes the current through another pair of terminals. NPN is one of bipolar transistors, consisting of a layer of P-doped semiconductor (the base) between two N-doped layers. A small current entering in the base is amplified to produce a large collector and emitter current. This NPN transistor is used as a switch to keep the setup in ON or OFF condition through digital signals.



Figure 6, transistor

EXPERIMENTAL SETUP

Connecting the components

All the required components are connected with each other as shown in the circuit diagram. The push button (forward button) in the 3D printing pen is connected with the collector of the NPN transistor, the other point is connected with the ground pin of ARDUINO and emitter of the transistor. The base pin in the transistor is connected with the ARDUINO board with pin 6. The reason to use a transistor is to make the circuit as a digital on/off switch. It will help the device to run the motor or off the motor when it receives digital signals. The ARDUINO board can be programmed accordingly to run the device.

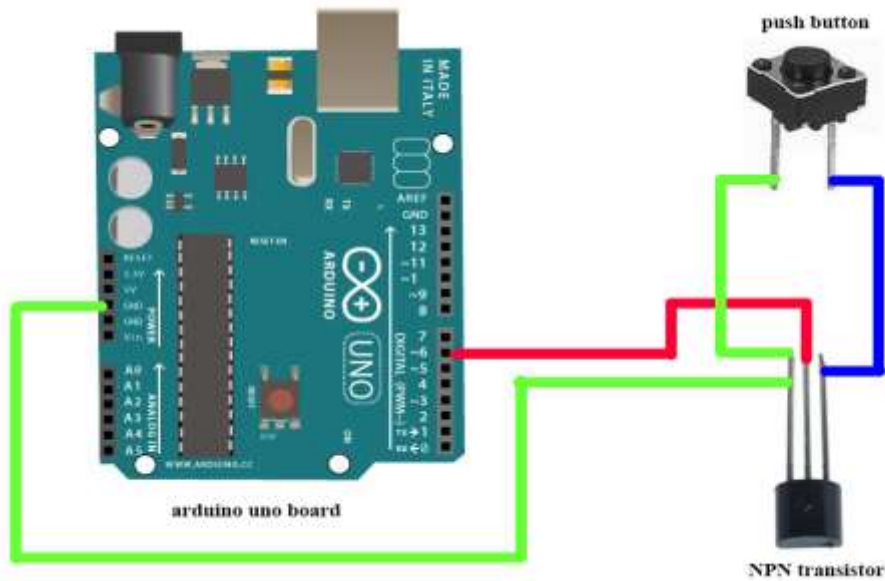


Figure 7, circuit set up

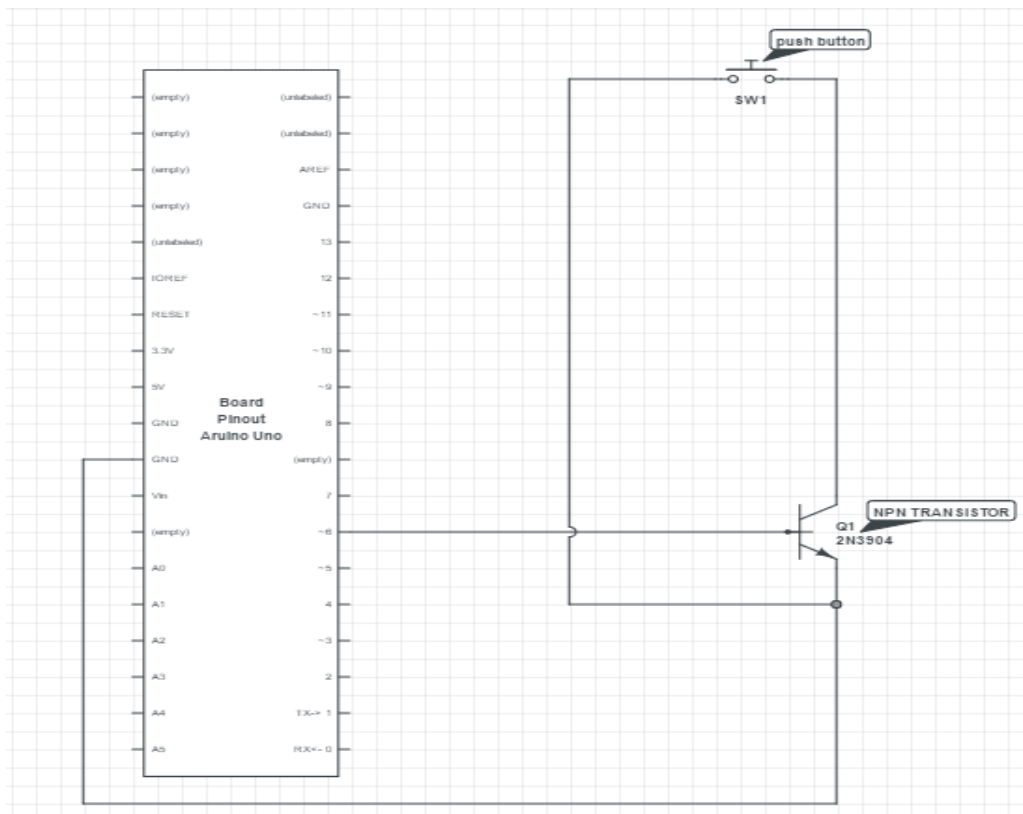


Figure 8, circuit setup

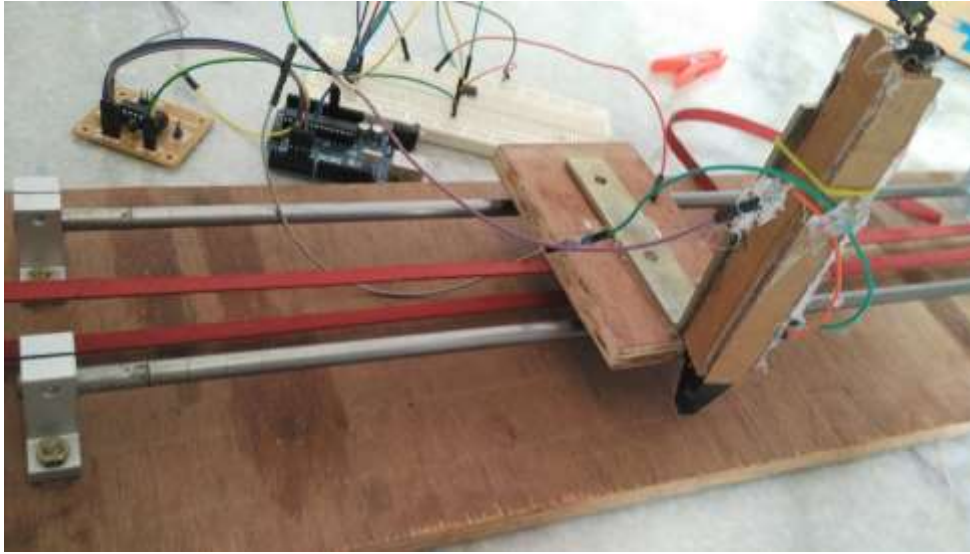


Figure 9, 3d printing pen attached with carriage of 3d printer (only one axis)

Design and analysis

Designing and thermal analysis is done with solidworks. The analysis is done in thermal part. Below part is loaded with temperature 150°C (hot end nozzole) and it shows that the device can be handle properly in that temperature.



Figure 10, exploded view

Model name: Assem4
Study name: Thermal 1(-Default-)
Plot type: Thermal Thermal1
Time step: 60 time : 30 Seconds

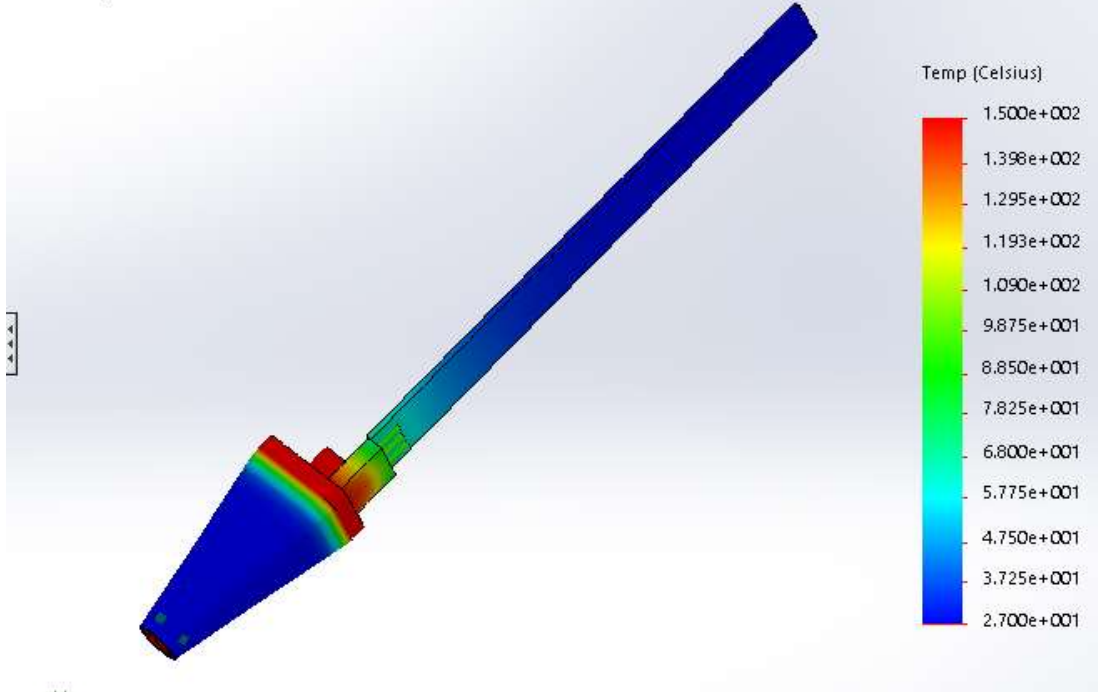






Figure 11, thermal analysis result

Price comparison

Table 1 price comparison

3d printing pen parts	3d printer parts
<p>Hot end</p>  <p>600 INR</p>	<p>Hot end</p>  <p>1500 INR</p>
<p>Small geared DC motor</p>  <p>500 INR</p>	<p>Stepper motor with extruder gear</p>  <p>3500</p>

<p style="text-align: center;">Mother board</p>  <p>1200 INR</p>	<p style="text-align: center;">NOT REQUIRED</p>
<p>Total 2600 INR (approx.)</p>	<p>5000 INR (approx.)</p>

CONCLUSION

To reduce the price of 3d printer, 3d printing pen is the efficient way in terms of price and its switchability. It can replace the 3d printer parts like the hot end parts, the extruder and the motor which are very costly. Since it is small in size it can also be handled easily and can be replaced easily. And at the end we can have two things , a 3d printing pen as well as a 3d printer.

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