

“UPGRADATION OF A LOW COST 3D PRINTER USING ARDUINO”

*DEPARTMENT OF MECHANICAL ENGINEERING
SONARGAON UNIVERSITY*

147/1, Green Road, Tejgaon, Dhaka-1215

Course Title: Project and Thesis

Course code: ME 400

Submitted By:

Name: Omar Faruk
ID: BME1803016335



Neamotuzzaman Khan
ID: BME1803016091

Name: Azmeer Hosen Sajib
ID: BME1803016341

Md. Mokammel Haque
ID: BME1803016100

Name: Md.Firoz Hossain
ID: BME1803016471

Sheikh Firoj Ahmed
ID: BME1803016288

Under the Supervision of

Md. Mainol Hasan

Assistant Professor
Department of Mechanical Engineering,
Sonargaon University,
Dhaka, Bangladesh.

Declaration

We hereby declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of Md. Mainol Hasan, Assistant Professor of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thereof has been or is being submitted elsewhere for the award of any degree,

Md. Mainol Hasan

Assistant Professor
Department of Mechanical Engineering,
Sonargaon University,
Dhaka, Bangladesh

Approval

This is to certify that the project on "UPGRADATION OF A LOW COST 3D PRINTER USING ARDUINO" by (Name: Neamotuzzaman Khan ID: BME1803016091 Name: Omar Faruk ID: BME1803016335 Name: Azmeer Hosen Sajib ID: BME1803016341 Name: Md.Firoz Hossain ID: BME1803016471 Name: Sheikh Firoj Ahmed ID: BME1803016288 Name: MD.MOKAMMEL HAQUE ID: BME1803016100) has been carried out under our supervisor. The project has been carried out in partial fulfillment of the requirement for the degree of Bachelor of Science (BSc) in Mechanical Engineering of the year 2022 and has been approved as to its style and contents.

Md. Mainol Hasan

Assistant Professor

Department of Mechanical Engineering.
Sonargaon University, Dhaka, Bangladesh.

Acknowledgement

The author wants to express gratefulness, regard, gratitude and sincere thanks to supervisor Md. Mainol Hasan Department of Mechanical Engineering, Sonargaon University (SU), for his guidance and valuable counsel in execution and completion of the study without which it would be impossible to carry out the work. Also thanks to MD. Mostofa Hossain, Professor and Head of the Department of Mechanical Engineering, (SU) for giving us permission to use laboratory facilities of the department. Author grateful to the teachers who helped us directly or indirectly which was very necessary to complete the thesis work. Finally, we are also grateful to the vice chancellor of Sonargaon University (SU) for his overall support to finish the project works.

Abstract

3D printing technology is one type of additive manufacturing processing in which three dimensional solid objects can be created by consecutive layers. It is often referred to as rapid prototyping. In this process, 3D models are easily generated on a relatively sized system linked to a device containing object blueprints where this idea of custom production is an exciting one. By using inkjet printing technology, this innovative approach for making g 3D models saves time. To create an overall structure in its own way this technology is often preferred. The major part used to develop a pattern is the cartridge which can be used in most applications such as jeweler design, Architecture domain, Health care, and Engineering. Most required design is created with the help of Computer-Aided Design or 3D Scanner where the cost of a 3D printer is merely high; so a cost-effective low-cost 3D printer with suitable components is fabricated.

Content

CHAPTER -1

1.1 Introduction.....	8
1.2 Scope of the Project.....	9

CHAPTER -2

2.1 Background.....	11
---------------------	----

CHAPTER -3

METHODOLOGY:

3.1 Nema 17 Stepper Motor.....	13
3.2 Arduino Mega 2560.....	13
3.3 Ramps 1.6 held.....	14
3.4 Dvr8824 Stepper motor driver.....	14
3.5 Extruder full set with fan.....	15
3.6 Smooth Rod.....	16
3.7 Treaded rod.....	16
3.8 LM8UU 3D Printer Linear Bearing.....	17
3.9 Gt2 Timing Belt.....	17
3.10 10GT2 20 teeth Ball Bearing Idler.....	18
3.11 Teeth Pulley.....	18
3.12 End Stop Switch.....	19
3.13 Custom stainless steel frame :.....	19
3.14 stainless Steel Bed plate.....	20
3.15 M3 Screws.....	20
3.16 DC-12V 30A Switching Power Supply Module.....	21
3.17 Graphical Display.....	21
3.18 Filament 1.75 mm.....	22
3.19 Working Principle of 3D Printer.....	23
3.20 Design Concept.....	24
3.21 Final Product.....	25
3.22 Printed sample model.....	26

CHAPTER –4

Discussion and Conclusion:

4.1 Comparison of 3D Printer from previous project.....	29
4.2 Advantage of Low Cost 3D Printer.....	30

4.3 Technical Problems and Difficulty of our 3D Printer	31
4.4 Parts Changed or Added for Upgrade.....	35
4.5 Conclusion.....	37
4.6 Reference.....	38

LIST OF FIGURES:

3.1 Nema 17 Stepper Motor.....	12
3.2 Arduino Mega 2560.....	13
3.3 Ramps 1.6 held.....	14
3.4 Dvr8824 Stepper motor driver.....	15
3.5 Extruder full set with fan.....	15
3.6 Smooth Rod.....	16
3.7 Treaded rod.....	16
3.8 LM8UU 3D Printer Linear Bearing.....	17
3.9 Gt2 Timing Belt	17
3.10 10GT2 20 teeth Ball Bearing Idler	18
3.11 Teeth Pulley.....	18
3.12 End Stop Switch	19
3.13 Custom stainless steel frame :.....	19
3.14 stainless Steel Bed plate.....	20
3.15 M3 Screws.....	20
3.16 DC-12V 30A Switching Power Supply Module.....	21
3.17 Graphical Display.....	21
3.18 Filament 1.75 mm	22
3.19 Working Principle of 3D Printer	23
3.20 Design Concept	24
3.21 Final Product	25
3.22 Printed sample model	26

Chapter-1

1.1 Introduction

Any type of 3D object can be created in additive manufacturing (AM). One of the most popular file types that the 3D printers can read is Stereo lithography (STL). With computer-aided design (CAD) kit, a 3D printer or a basic digital camera and photogrammetric software, 3D printable models can be made. 3D printed CAD-generated models result in reduced errors that can be corrected before printing, facilitating testing of the configuration of the item before printing; the present innovation is usually concerned with advanced development processes. More precisely, the innovation explains the design and manufacturing of an Advanced Desktop 3D Printing System that works on the Fused Deposition Modeling (FDM) principle. In the 1980s, 3D printing technology first became visible; they were called Rapid Prototyping (RP) technology at the time . A new open design approach capable of driving self-directed environmental growth has been made possible by the technical evolution of the 3-D printer, universal internet connectivity, and cheap computing. Tissue engineers have used rapid prototyping (RP) techniques for creating three-dimensional (3D) porous scaffolds. RP technologies allow complex scaffold geometries with a completely integrated pore network to be built and manufactured. Scanning projection stereo lithography has been used to create a 3D printer. Due to the usage of utility resin material, the Fused Deposition Modeling (FDM) 3D printer was used. A new calcium phosphate powder-binder method has been developed for the 3D printing of patient-specific implants. The selection of binder for a particular material composition to create scaffolds with desired microstructure and physicochemical properties are one of the essential aspects of 3D powder printing (3DPP). For research, education, and environmental growth, low-cost 3D printing was used. While still in its infancy, low-cost, three-dimensional (3D) desktop printing is increasingly maturing with seemingly infinite potential. Using a 3D printer, patient-specific molecular imaging phantoms have evolved. The primary goal of the thesis is to investigate the rapid prototyping technologies directly from patient CT data Organ printing computer-aided jet -based 3D tissue engineering for the development of patient-specific, cost -effective liquid fill-able phantoms. Three-dimensional Nan fibrous scaffolds offer a superior environment for the promotion of cell functions relative to conventional in-vitro cell culture materials. Optical 3D gel printers have been produced for the manufacturing of free-form soft and liquid industrial materials. Gels have special properties such as transparency, biocompatibility and low friction, and are soft and damp materials. It contrasts 3D printing features and implementations with mass customization and other development methods. A transparent solid acrylic plastic which is watertight, rigid, and sufficiently durable to survive numerous assembly and scanning procedures is the final print material. The low-

cost printer is the most fitting printer for home 3D printers. The FDM 3D printer has the issue of creating layer grooves on the 3D printed structure's surface. 3D printing makes it possible for the manufacture limited amounts of personalized products at relatively low prices. For each of the popular 3D printing technologies (Three Dimensional Printing, Fused Deposition Modeling, Selective Laser Sintering, Stereolithography, and 3D Plotting / Direct-Write / Bio Printing), the main materials and technology advancements over the last five years are listed. With a high production price, the latest 3D printing process is very time-consuming. The main purpose of this project is not only to reduce the expense of the 3D printer but also to focus on its performance and time constraints. 3D printing technology is an additive processing technology in which a three-dimensional model is produced. This technology is a technology for fast prototyping

1.2 SCOPE OF THE PROJECT

Includes (list of Deliverables):

Base electronic and electromechanical components fundamental to -3D axis control. rendering software

Communicating with the control board controlling axes and extruder. - Cartesian frame prototype capable of

Accurate axial motion control using stepper motors.

Cartesian frame prototype capable of accurate axial motion control using stepper motors.

Includes (list of Deliverables):

Control Board enclosure –

Board enclosure mounted to Cartesian Frame.

Memory card and LCD display

Does Not Include:

3D rendering software

Any material extruded from the system that does not resemble a polygonal form.

Material spool and spool mounting base.

Calibration of the control system.

Project Completion Criteria:

Working three axis control systems communicating with software. Material extrusion in controlled manner

with appropriate temperature settings.

Cartesian frame capable of mounting a stepper motor on each axis

Able to print 3D model from memory card

Checking the technical problem and difficulty of the upgraded 3D printers

Chapter-2

2.1 Background

The first documented iterations of 3D printing can be traced back to the early 1980s in Japan. In 1981, Hideo Kodama was trying to find a way to develop a rapid prototyping system. He came up with a layer-by-layer approach for manufacturing, using a photosensitive resin that was polymerized by UV light. Although Kodama was unable to file the patent requirement of this technology, he is most often credited as being the first inventor of this manufacturing system, which is an early version of the modern SLA machine. Across the world a few years later, a trio of French researchers was also seeking to create a rapid prototyping machine. Instead of resin, they sought to create a system that cured liquid monomers into solids by using a laser. Similar to Kodama, they were unable to file a patent for this technology, but they are still credited with coming up with the system. That same year, Charles Hull, filed the first patent for Stereo lithography (SLA). An American furniture builder who was frustrated with not being able to easily create small custom parts, Hull developed a system for creating 3D models by curing photosensitive resin layer by layer. In 1986 he submitted his patent application for the technology, and in 1988 he went on to found the 3D Systems Corporation. The first commercial SLA 3D printer, the SLA-1, was released by his company in 1988. But SLA wasn't the only additive manufacturing process being explored during this time. In 1988, Carl Deckard at the University of Texas filed the patent for Selective Laser Sintering (SLS) technology. This system fused powders, instead of liquid, using a laser. SLS fabrication machines in the Fundació CIM warehouse Fused Deposition Modeling (FDM) was also patented around the same time by Scott Crump. FDM, also called Fused Filament Fabrication, differs from SLS and SLA in that rather than using light, the filament is directly extruded from a heated nozzle. FFF technology has gone on to become the most common form of 3D printing we see today. These three technologies are not the only types of 3D printing methods that exist. But, they are the three that serve as the building blocks that would lay the groundwork for the technology to grow and for the industry to be disrupted.

1990-2010: Growth

In the 90s, many companies and startups began popping up and experimenting with the different additive manufacturing technologies. In 2006, the first commercially available SLS printer was released, changing the game in terms of creating on-demand manufacturing of industrial parts. CAD tools also became more available at this time, allowing people to develop 3D models on their computers. This is one of the most important tools in the early stages of creating a 3D print. During

this time, the machines were very different from those that we use now. They were difficult to use, expensive, and many of the final prints required a lot of post-processing. But innovations were happening every day and discoveries, methods, and practices were being refined and invented. Then, in 2005, Open Source changed the game for 3D printing, giving people more access to this technology. Dr. Adrian Bowyer created the RepRap Project, which was an open-source initiative to create a 3D printer that could build another 3D printer, along with other 3D printed objects. RepRapBCN in the middle of Fundacio CIM warehouse showing the RepRap Machines to visitors. In 2008, the first prosthetic leg was printed, propelling 3D printing into the spotlight and introducing the term to millions across the globe. Then, in 2009, the FDM patents filed in the 80s fell into the public domain, altering the history of 3D printing and opening the door for innovation. Because the technology was now more available to new companies and competition, the prices of 3D printers began to decrease and 3D printing became more and more accessible.

3 D Printing Now

In the 2010s, the prices of 3D printers started to decline, making them available to the general public. Along with the lowering prices, the quality and ease of printing also increased. The materials that printers use have also evolved. Now there are a variety of plastics and filaments that are widely available. Materials like Carbon Fiber and Glass Fiber can also be 3D printed. Some creative's are even experimenting with printing materials like chocolate or pasta! In 2019, the world's largest functional 3D printed building was completed. 3D printing is now consistently used in developing hearing aids and other healthcare applications, and many industries and sectors have adopted the technology into their everyday workflow.

It's safe to say that the history of 3D printing is still being written.

Chapter -3

METHODOLOGY

3.1 NEMA 17 STEPPER MOTOR:



Figure(3.1): NEMA 17 Stepper Motor

The motors are used to provide the necessary movements to different parts of the printer. We are using four NEMA 17 stepper motors to control the movements. It is a heavy duty motor which provide higher torque with 1.7 x 1.7 inch faceplate. The motor specifications are: •1.4 A to 1.7 A current/phase 15 volts -3 to 7 mH inductance/phase •43 N-cm torque •1.7 or 0.8 degrees/step (200/400 steps/rev)

3.2 ARDUINO MEGA 2560:



Figure (3.2): Arduino Mega 2560

The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities. The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTS (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC- to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Decimal

3.3 RAMPS 1.6 HELD:



Figure (3.3): Ramps1.6 Shield

Heated bed control with additional 11A fuse. Fits up to 5 stepper driver board. It is designed to fit the entire electronics needed for a RepRap 3D printer in one small package for low cost. The modular design includes plug in stepper drivers and extruder control electronics on an Arduino MEGA shield for easy service, part replacement, Additionally, a number of Arduino expansion boards can be added to the system as long as the main RAMPS board is kept to the top of the stack

3.4 Dvr8824 Stepper motor driver:



Figure (3.4): Dvr8824 Stepper motor Drivers with heat sink

The DRV8824 provides an integrated motor driver solution for printers, scanners, and other automated equipment applications. The device has two H-bridge drivers and a micro stepping indexer, and is intended to drive a bipolar stepper motor. The output driver block consists of N-channel power MOSFETs configured as full H-bridges to drive the motor windings. The DRV8824 is capable of driving up to 1.6 A of current from each output (with proper heat sinking, at 24 V and 25°C).

3.5 EXTRUDER FULL SET WITH FAN:



Figure (3.5): Extruder Full set with Fan

To control the movement of the filament the extruder is used which is basically a feeding system which have a cold top part that feeds the filament with the help of motor and gear and a hot part which is having heating arrangement to heat and melt the filament. The hot part is made up of brass bolt with a hole drilled for the movement of the filament. The drilled hole size varies with the sizes of filament available and here we used 3 mm wide filament.

3.6 SMOOTH ROD:

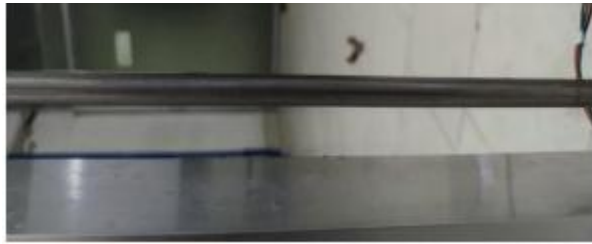


Figure (3.6): Smooth Rod

To move the printer bed and the printer head we are using a different rod which provides required degree of freedom. To controls the movement of the rods we are using motors, pulleys and belt arrangement. Here the Y-axis provides one degree of freedom by moving the frame back and front with the help of stepper motor and pulley arrangement. The rods used are: 4x 210 mm M 8 type threads. • 2x 350 mm M 8 type smooth rod. • 2x 375 mm M 10 type threads. The other movements are in Z-axis that is also controlled by another rod. This axis is an integral part of Y-axis construction and it provides the movement to the extruder axis i.e. it moves X-axis (extruder/nozzle) up and down with respect to the printer bed. The rods used are: • 2x 315 mm M 8 type smooth rod. 2x310 mm M5 type threads. The movement of Z-axis is governed with the help of 2 stepper motors for better accuracy. The third axial movement (X-axis) is given to the printer nozzle itself i.e. moving the nozzle left and right with the help of one motor, belt and pulley arrangement. The rods used are: - • 2x 375 mm M 8 type smooth rod

3.7 Treaded rod:

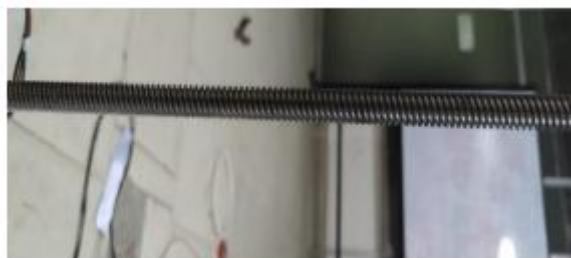


Figure (3.7): Treaded rod

Trapezoidal Threaded Rod is a metal rod with a continuous trapezoidal shaped thread across the entire length of the rod. Trapezoidal Thread is often used where large screw loads are required. Common uses are as the lead screw of a lathe or in a vise.

3.8 LM8UU 3D Printer Linear Bearing



Figure (3.8): LM8UU 3D Printer Linear Bearing

Flexible couplings are used to transmit torque from one shaft to another when the two shafts are slightly misaligned. .. In addition, they can also be used for vibration damping or noise reduction. A coupling designed to allow a limited angular movement between the axis of two waveguides.

3.9 GT2 TIMING BELT:



Figure (3.9): GT2 Timing Belt

Timing belts are a fantastic way to transfer rotational motion (from a stepper motor) into linear motion (along a rail) and these GT2 belts are excellent for the task. They have a special profile with rounded teeth which reduces backlash. Often use for precision 3D printers and CNC machines. This belt is 1164 mm long (582 teeth on a 2 mm tooth pitch) and is 6mm wide. It comes in a loop but you can of course cut it down if you need a shorter length.

3.10GT2 20 teeth Ball Bearing Idler:



Figure(3.10): Ball Bearing

In the timing belt mechanism, the type with a slotted hole in the inner ring or a bracket for tension adjustment is sometimes called the "tensioned bearing," and the type without an adjustment mechanism is sometimes called the "idler bearing. The purpose of an idler gear can be twofold. Firstly, the idler gear will change the direction of rotation of the output shaft. Secondly, an idler gear can assist to reduce the size of the input/output gears whilst maintaining the spacing of the shafts.

3.11 TEETH PULLEY:



Figure (3.11): Teeth Pulley

For precise motion control, GT2 belts and pulleys offer excellent precision at a great price. This pulley is meant for use with GT2 6mm wide belts; only MXL belts will slip due to the different tooth profile. This pulley has 20 teeth, and a 5mm inner bore. Two set screws can be used to attach it firmly to any 5mm diameter shaft such as one of our stepper motors. Full aluminum construction means these are very light and very durable.

3.12 END STOP SWITCH:



Figure (3.12): End stop switch

To stop the movements of the axis when datum position is reached the end stops are used. These switches basically act as a protection to save the machine from striking by cutting off the power when the axis reaches the end point. The end stops are needed at every axis end & they provide the range and zero position to the machine.

3.13 Custom Stainless steel frame :



Figure (3.13): Custom Stainless steel frame

Custom steel frame supports all the mechanical and electrical components that carry out the actual printing work. It determines the build volume of the 3D printer. It gives the printer its robust look, as well as its aesthetic appearance.

3.14 Stainless Steel Bed plate:



Figure (3.14) Stainless Steel Bed plate

Stainless Steel bed have very high strength and heat-resistance, making it ideal for high temperature filament out there like ABS and PEEK. You would see this type of bed used with a magnetic PEI bed because it sticks very well, and gives you a smooth surface for the first layer. All you have to do it let it all cool down before removing the steel plate, then flexing it until your print pops off. Steel is an addition that many people wish they had gotten sooner, to save them several hours of trying to get extruded filament to stick down.

3.15 M3 Screws:



Figure (3.15): M3 Screws

We have used M3 screws to fix motor with 3D printed mounts

3.16 DC-12V 30A Switching Power Supply Module:



Figure (3.18): power supply board

The ATX-12V system is used to supply power to the different parts of the machine. ATX is an advanced technology extended having the motherboard configuration which is manufactured by Intel in 1995, Its specifications basically used to identify its dimensions and it consists of mounting points, input/output panel, power and different connector interfaces between computer and case, a motherboard and a power supply

3.17 Graphical Display:



Figure (3.19): Graphical display

The intelligent controller includes an SD card reader, an encoder and a 20-character x 4-row LCD display. There simply can be connected using the Smart adapter with your RAMPS 1.6 plate. After successful connection, the SD card smart controller provides instead of your computer for the power supply. The smart controller by the encoder creates all other operations, such as calibration or axis movement etc. The 3D design is saved by G-code design on the SD card without printing by computer.

3.18 FILAMENT 1.75 mm:



Figure (3.18): Filament 1.75mm

There are numerous filaments available but here Acrylonitrile Butadiene Styrene (ABS) is used and its chemical formula is $(C_8H_8)_x-(C_4H_6)_y(C_3H_3N)_z$. Its glass transition temperature is 108 °C. It is amorphous in nature and made up of polymerizing styrene and acrylonitrile with addition of polybutadiene. We have used PLA (Poly lactic acid) for our 3D printing, its operating temperature is 190-230 degree Celsius and chemical formula is $(C_iH.O_2)_n$

3.19 WORKING PRINCIPLE OF 3D PRINTER:

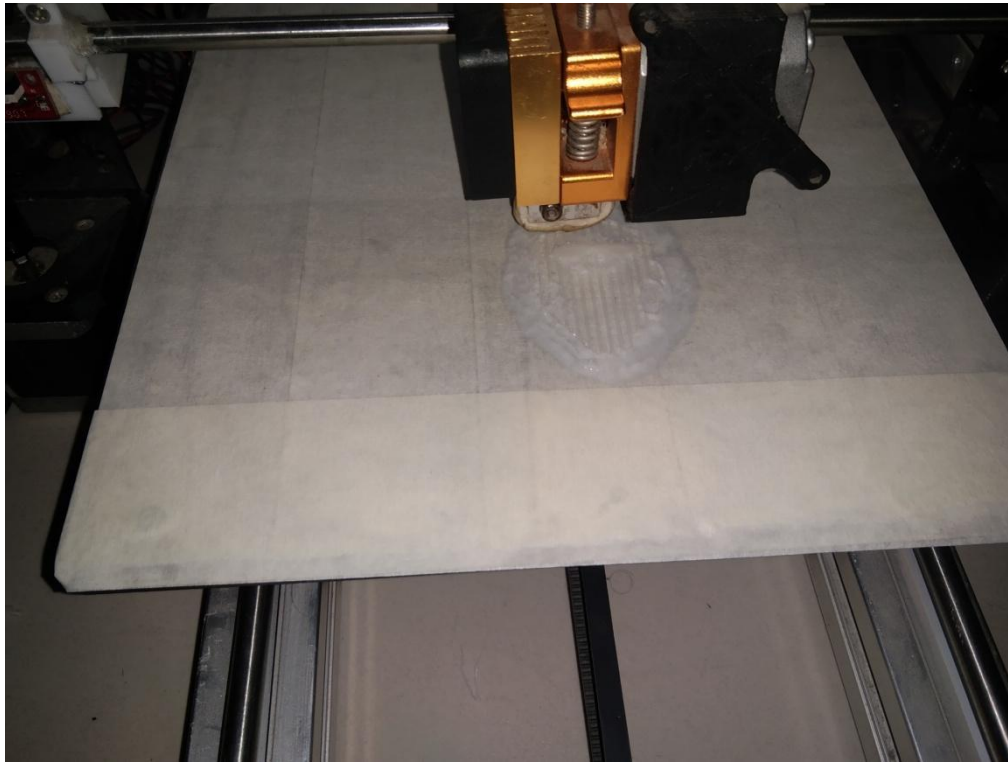


Figure (3.19): 3D PRINTER

After we made the 3D printer we downloaded the software Marlin Firmware, Arduino and pronterface, ultimaker cura. Then we did the configuration on the Marlin using laptop connected with Arduino so that the configuration automatically installs in the Arduino and did some editing according to our 3d printer hardware setup. Then we did some setting set up on the ultimaker cura for our 3D printer configuration and filament. After that we have chosen a prototype model which we want to make and we have made a G- Code file of 3D model we want to print in ultimaker cura.

Steps:

1. In the ultimaker cura slicer software we chose the model of 3D printer that match with our 3D printer configuration
2. Then we chose our printing material (Generics PLA)
3. Then set up the we set up print quality (Normal – 0.15)
4. Then set up the infill density and pattern (20-25% , Grid)

5. Then set up the bed and nozzle temperature (Bed:0 , Nozzle:190)
6. Then setup the print speed (60 mm/s)
7. At last add the Support or Adhesion if needed and click on slice button to Convert the 3D model into G-Code

After that, we inserted a memory card into the laptop and made a copy of the G-Code File in it. We need to load the memory card which we have already made G-Code into the memory card inserter behind the graphical display. when the product fully loaded on the marlin firmware on the Arduino, then click on the print then the heat bed temperature will change up to our selected temperature. At the same time the extruder will come his working position and we need to put a paper tape on the steel bed so the product can remove from the bed after print. When the nozzle is fully heated then the printing will start. The product making time depend on the product size and speed and quality of printing.

3.20 Design Concept:



Figure (3.20): Design Concept 1

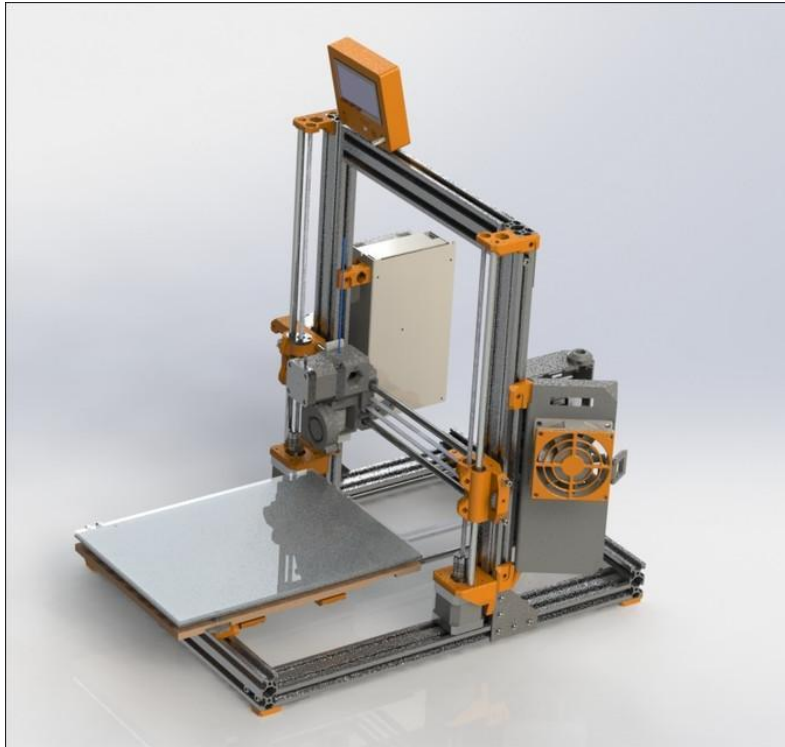


Figure (3.21): Design Concept 2

3.21 Final Product:

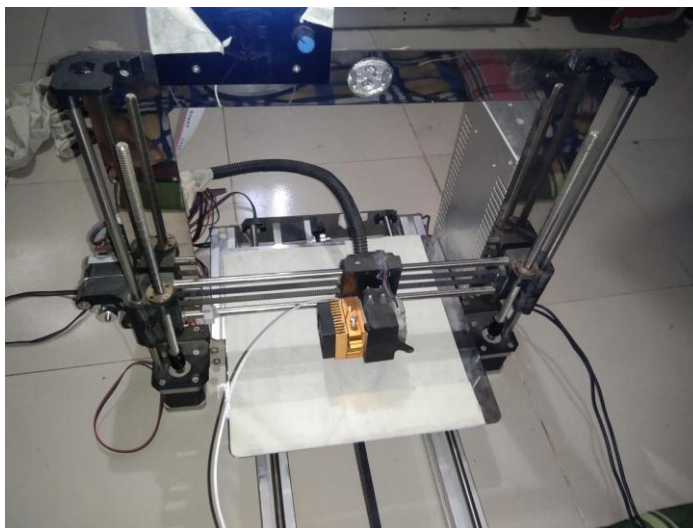


Figure (3.22): 3D printer project

3.22 3D Printed sample model

The figure 3 below shows some of the samples printed using the printer. The printer can print complicated shapes with ease and also the software develops the support material itself without any human interaction depending upon the configuration of the workpiece. However we can change the support if required. These specimens shown below are further used to study the mechanical & physical properties of the filament used however they results are not discussed here.



3d printed model



Fig: Human Skull Anatomy



Fig: Scoot the warrior



Fig; Mike the robot

Chapter -4

DISCUSSION AND CONCLUSION:

4.1 Comparison of 3D Printer with previous 3D printer project



Fig. Upgraded 3D Printer

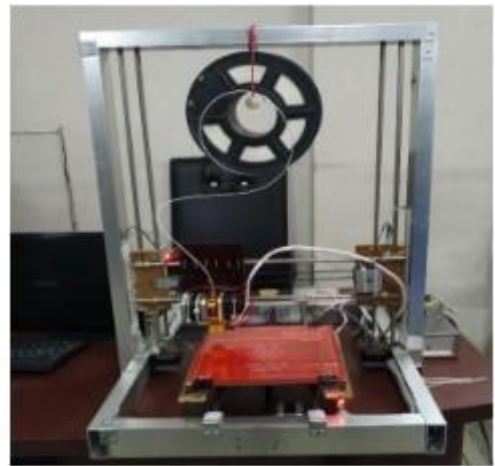


Fig. Pervious 3D Printer

Upgraded 3D Printer (Arduino based)	Low cost 3D Printer (Arduino based)
1) Moderate cost, compact size and cost around only TK. 18000	1) low cost, cumbersome size Min TK.16500
2) Electric power consumption is efficient, used only 180 Watts.	2) Electric power consumption is inefficient, used minimum 220 watts.
3) It can be easily operated , has more automation and needs less attention when printing.	3) Operating it is easy but the operating process is less automated and needs more attention.

4) Less likely to malfunction and break down. Can be operated for long hours and days and print faster.	4) More likely to malfunction and break down. Can't operate for long hours let alone days and prints.
5) Print quality and accuracy is better.	5) Print quality and accuracy is moderate.

4.2 ADVANTAGE OF 3D PRINTER:

Customization - A major advantage in 3d printing. With just a raw material, a blueprint and a 3d printer, one can print any design no matter how complex it might be.

Constant Prototyping and Increased Productivity - enables quick production with a high number of prototypes or a small-scale version of the real object in less time than using conventional methods.

This helps designers to improve their prototypes, for any design flaws that may affect the quality of the product. Affordability - The initial cost for setting up a 3d printing facility is definitely high; however, it is much cheaper compared to labor costs and manufacturing costs while using the

conventional way. Adding to it, is the fact that the cost of producing or manufacturing products using 3d printing technology is equal for small-scale and mass manufacturing.

Storage – Traditional manufacturing produces additional products that you probably know you will eventually need thus storage problems arise. However, 3d printing technology, products can be “printed” when needed thus excess products are eliminated and no storage cost is required.

Health Care - With the advancement of technology, a customizable human body parts and organs can now be manufactured this technology is termed as Bio printing. Although right now this is still experimental, the potential is huge. This breakthrough will not only address the shortage of organ donors, but also organ rejection since the organs that are built will consist of the patient's unique characters and DNA.

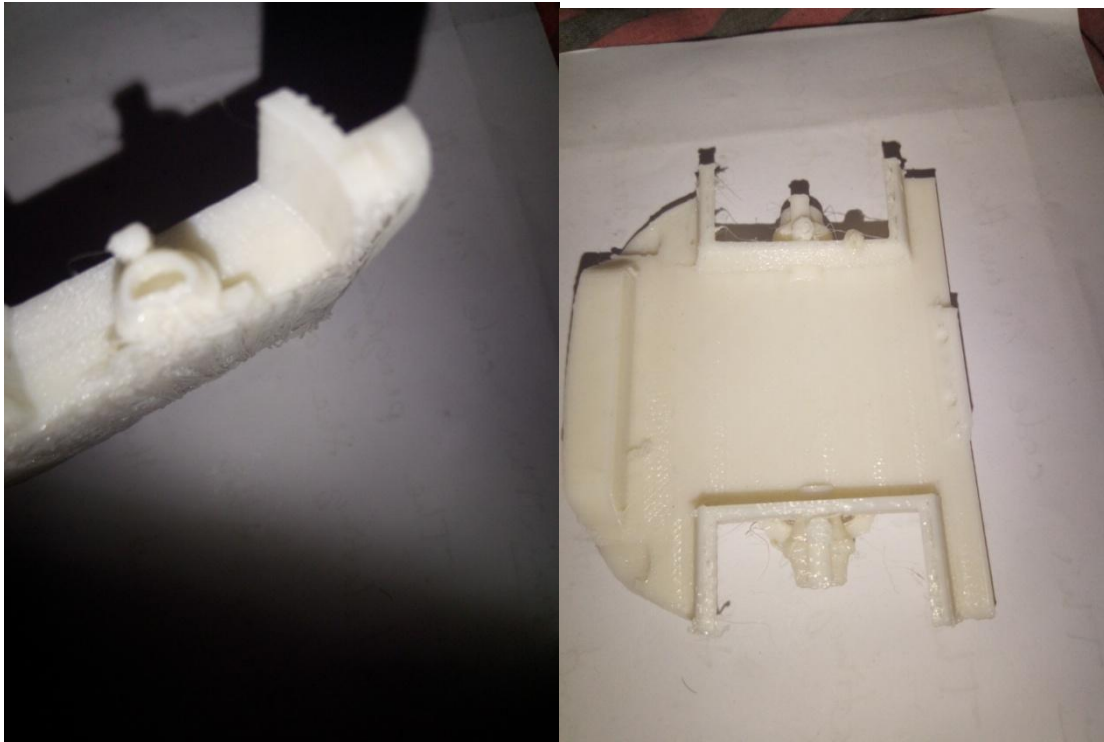
4.3 Technical Problems and Difficulty of our 3D Printer:

Our 3D printer can print fine quality single 3D models even without support. But we need improvement to print multiple objects at once. For test and research purposes we printed various parts of a car model from a free source. Let's discuss it below –

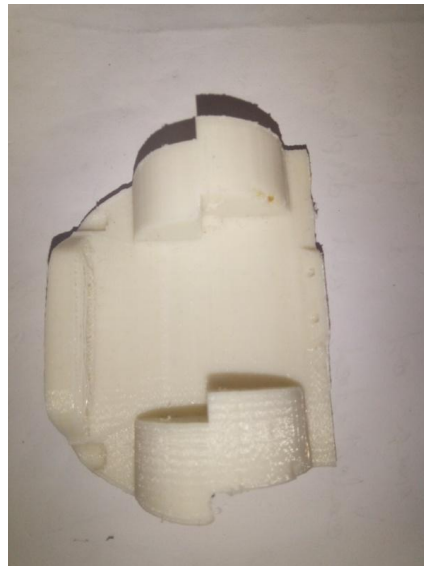
- 1) When we printed the back upper frame of the car we noticed excess material sticking with the object surface. Later we have to remove them.



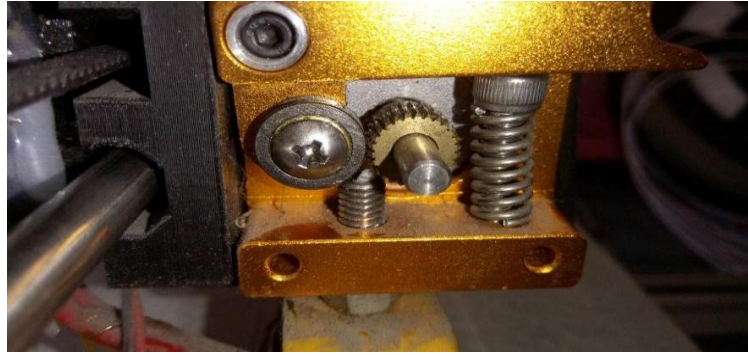
- 2) If there is voltage drop or load shedding the printer print deformed 3D mode or stops 3D printing. We have to start from scratch again.



- 3) The printer has to stand still during printing or we will get displacement printed products
Also pay attention to timing belt is tied hard.to prevent ghost printing.



- 4) After consecutively printing for 3 days the nozzle was blocked by PLA material and we have cleared the nozzle. But after a short time we again started printing without problems.



5)After printing various parts of the car model, we weren't able to accurately put them together.







Now let's print with different material that has different color and printing temperature





4.4 Parts Changed or Added for Upgrade:

Previous parts	New parts
<p>Ramps 1.4 held</p> 	<p>Ramps 1.6 held</p> 
<p>Dvra4988 stepper motors</p> 	<p>Dvr8824 Stepper motor driver</p> 

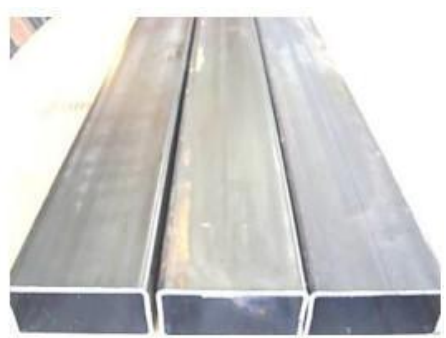
Linear Ball Bearing



LM8UU 3D Printer Linear Bearing



Aluminum Channel and Plywood



Custom stainless steel frame



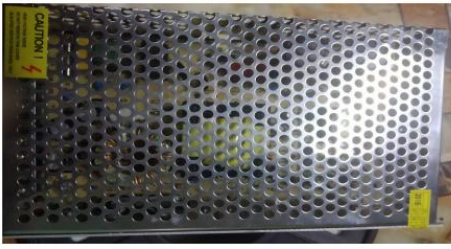
PCB Heat Bed



stainless Steel Bed plate



DC Power Supply 12V, 20 Amp



DC-12V 30A Switching Power Supply



None

Graphical Display and memory card



4.5 Conclusion:

The 3D printer is a new technology which has lots of potential and its proper analysis based upon its impact on the society, environment, industries etc. is needed to be done. It is having both advantages and limitations and all of them are needed to be kept in mind while selecting and working with 3D printers. Basically this technique is very different from traditional technique in which subtractive approach was used to manufacture a component while here additive approach is used to manufacture any component. It basically creates the object layer by layer and so it reduces the wastage in form of chips etc. Also this technology creates the custom fit objects in least possible time with good accuracy and also it is just in time manufacturing where objects are manufactured just when they needed. It provides flexibility in terms of complicated shapes and in terms of materials as recent development shows that it can use almost all the materials for printing.

The recent developments in the technologies like more accurate lead screws, more accurate motors, good sensor system, more reliable feedback loop etc. shows that the accuracy of 3D printers is improving day by day. The further development in the technologies will remove all the barriers of this technique and soon the day will come when only 3D printers will be used for manufacturing all the parts, components, objects. So we can say that soon the 3D printers will lead the market and it will completely remove the conventional manufacturing systems and it has the potential to create the next industrial revolution where only 3D printers will dominate in each and every field.

4.6 References:

- [1] change K-H 2013, Chapter 6 – Product cost Estimating BT _ Product Manufacturing and Cost Estimating using Cad/Cae. In the computer Aided Engineering Design Series. Boston: Academic Press, 237-294.
- [2] Charles Hull, 2016. Stereolithography (3D Printing).
- [3] Dimitrov D, de Beer N, Hugo P, Schreve K, 10.08.2014. Three Dimensional Printing A2-Hashmi, Saleem. In Batalha GF, Tyne CJ Van, Yilbas BBT-CMP,eds. Oxford: Elsevier, 217-250.
- [4] Efundai. Rapid Prototyping: An Overview, Efundai.com
- [5] FDM Technology, About Fused Deposition Modeling Stratasys
- [6] Fresques T, Cantrell D. 2015. The development of a framework between the 3D printed patterns and sand-cast work pieces Ismail Fidan,5(2), 170-185
- [7]Gebhardt A. 2011. Additive Manufacturing Design and Strategies BT- Understanding Additive Manufacturing. In: Hanser, 103-128.n
- [8] Gibson I, Gao Z, Campbell I, 2004. A comparative study of virtual prototyping and physical prototyping. Int Journal of Manufacturing Technology Management 6(6), 503-522
- [9]Herrmann K-H, Gartner C, Gullmar D, Kramer M, Reichenbach JR. 2014. Printing of MRI compatible Why every MRI research group should have a low-budget 3D printer, Medical Engineering & Physics 36(10), 1373-1380.
- [10] Javaid M, Kumar L, Haleem V. 2015. Product Design and Development using Poltjet Rapid Prototyping Technology, Control Theory Informatics, 5(3), 12-20.
- [11] Kumar L, Kumar V, Haleem A, 2016 Rapid Prototyping Technology for new product Development, international journal of innovative science, engineering and technology,3(1), 287- 292.

[12] Kumar V, Haleem A, Rajesh.2016. Design and Development of Thermal Rapid Prototyping Machine and Its Application, international Journal of Emerging Science and Engineering,4(2),101- 106.

[13] Kumar V, Kumar L, Haleem A, 2016. Selection of Rapid Prototyping Technology Using an ANP Based Approach. IOSR Journal of Mechanical and Civil Engineering,13(4) 71-78.

[14] Kumar V, Kumar L, Haleem A, of Rapid Prototyping Technology ranking using an ANP approach and sensitivity analysis, international Journal of Engineering Science,5(9) 93-103.