

3D PRINTER

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Abstract: 3D printing also known as Additive manufacturing technology has been dubbed the next big thing and is as equally widespread as the cellular telephone industry. 3D printers print objects from a digital template to a physical 3-dimensional physical object. The printing is done layer by layer (Additive manufacturing) using plastic, metal, nylon, and over a hundred other materials. 3D printing has been found to be useful in sectors such as manufacturing, industrial design, jewelry, footwear, architecture, engineering and construction, automotive, aerospace, dental and medical industries, education, geographic information systems, civil engineering, and many others. It has been found to be a fast and cost effective solution in whichever field of use. The applications of 3D printing are ever increasing and it's proving to be a very exciting technology to look out for. In this paper we seek to explore how it works and the current and future applications of 3D printing.

Keywords: Printer

I. INTRODUCTION

History of printing starts from the duplication of images by means of stamps followed by the flat bed printing process in the 18th century. In the mid 19th century color printing called Chromolithography became very popular. A revolution occurred when the print workings, specifically a 2D printer was used as a peripheral device, which made a persistent human readable representation of the graphics a text in paper. After some years the concept of 3D printers starts evolving, a new way to look at the past printing technologies.

Our report emphasizes on the design and development of a low-cost 3D printer. 3D printer basically is a concept to make or print the objects layer by layer and thus making it so called "Three dimensional". Nowadays 3D printers available are of higher costs that is due to the printing technology used and the material used in 3D printers, so this project sparks upon making the 3D printer low cost by using the scrap materials and designing a frame for the 3D printer

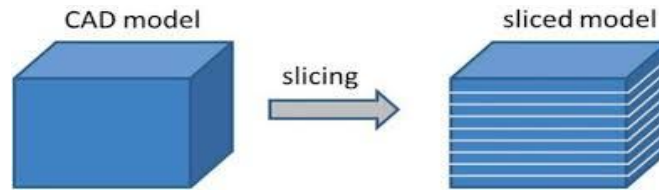
The main aim of this project is to make the 3D printer available to a common man making this equipment easy to operate and automate working once the command and specific design is given to this device. So operating time will automatically decrease as it can handle the task without any human intervention. This also makes this device reasonable and approachable to everyone in this project. This project deals or in other words targets the people who have cost as a main constraint and thus making a 3D printer useful in school laboratories, making imitation jewelry for women, automobile industries, making a prototype material in industries etc.

II. HOW IT WORKS

As shown in figure 1, 3D printing starts by making a virtual design of the object you want to create. The virtual design is used as a template of the physical object to be created. This virtual design can be made using a 3D modeling program such as CAD (Computer Aided Design) to create a design from scratch. Alternatively a 3D scanner can be used for an existing object. This scanner makes a 3D digital copy of an object and puts it into a 3D modeling program.

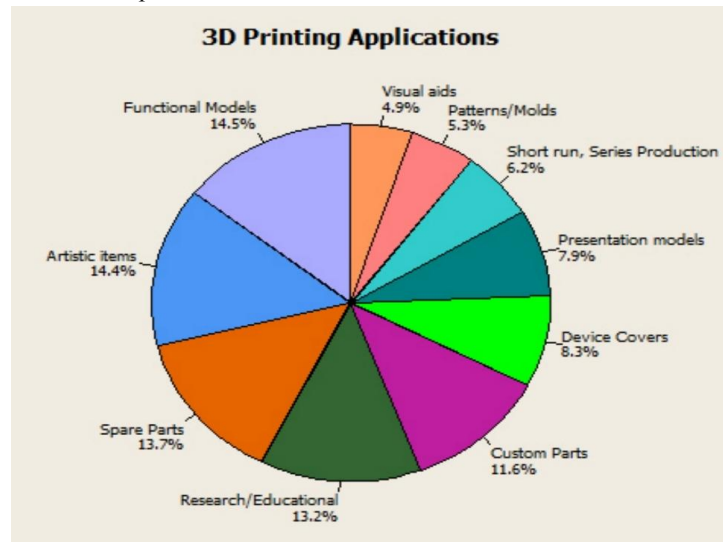
The model is then sliced into hundreds or thousands of horizontal layers in preparation for printing. This prepared file is thus uploaded in the 3D printer, which will see the printer creating the object layer by layer as shown in figure 2 below.

Here, every slice (2D image) is read by the printer and proceeds to create the object layer by layer and the resulting object has no sign of layering visible, but a 3 dimensional structure



III. APPLICATIONS

3D printing technology has been applied in various and varied sectors. Figure 3 shows the various kinds of usages of 3D printing which include research, artistic items, visual aids, presentation models, device covers, custom parts, functional models, and patterns as well as series production.



3.1 Construction

In China they were able to build 10 one-story houses in a day, a procedure which normally takes weeks to months to complete. 3D printing thus provides a cheaper, faster and safer alternative relative to more traditional construction. Four giant 3D printers were used by WinSun Decoration Design Engineering to build houses in Shanghai; by using a mix of cement and construction waste to construct the walls layer by layer. Each of these houses is 10 meters wide and 6.6 meters high. With each house costing less than \$5000, it has proved to be both cost and time effective.



3.2 Medicine

3.2.1 Hearing aids

Hearing aids have been made using 3D printing technology.

3.2.2 Bio printers

Organ printing or body part printing is being printed and some parts are being used as implants of actual body parts. Body parts such as titanium pelvic, plastic tracheal splint, titanium jaws to mention but a few have been printed.

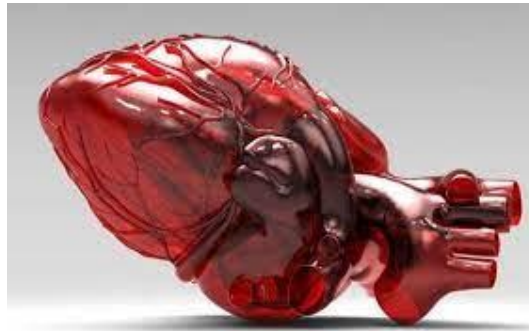


Figure: Printed 3D Heart.

Figure shows a 3D printed human heart. New bio printers actually print human tissue for both pharmaceutical testing and eventually entire organs and bones. Tissue engineering has made tremendous strides as they have been able to print 3D blood vessels. This was achieved by combining advances in 3D bio-printing technology and biomaterials through vascularisation of hydrogel constructs.

3.2.3 Digital Dentistry

People are getting 3D printed teeth customized for the individual. Dental Implants are being made on a commercial level and making the whole process faster and more efficient. Before fake teeth used to be one- size- fits all depending with age. Now, people of the same age can have different sized teeth resulting in people getting discomfort with ill-fitting fake teeth. Thus, customized implants have really brought a sigh of relief to the consumers as they are now able to receive teeth suited for them.all depending with age. Now, people of the same age can have different sized teeth resulting in people getting discomfort with ill-fitting fake teeth. Thus, customized implants have really brought a sigh of relief to the consumers as they are now able to receive teeth suited for them.

3.2.4 Prosthetics

A multitude of people are in need of surrogate body parts from people born without limbs to accident victims. The cost of getting surrogate body parts used to be extremely expensive but thanks to 3D printing; the cost has been significantly reduced. Prosthetics has really done wonders to disabled people with the likes of Paralympics champion Oscar Pistorious being a world famous example. Oscar Pistorious had his legs cut off as a child, but that did not stop him from running, let alone in the Olympics.

3.2.5 Bionics

Researchers from Princeton and John Hopkins were able to make a 3D printed bionic ear. The hearing is done through electronics. This development could help deaf people to hear.

3.2.6 artificial Organs

Additive manufacturing of stem cells has also led to various possibilities in printing artificial organs, although most of the work is still in the experimental stage. For instance, through 3D printing Heriot-Watt University scientists were able to produce clusters of embryonic stem cells. An endless world of possibilities awaits this world with the prospects of printing actual functioning artificial organs.

3.2.7 Manufacturing

3D printing has introduced an era of rapid manufacturing. The prototyping phase is now able to be skipped and go straight to the end product. Car and airplane parts are being printed using 3D printing technology. The printing of parts is being done in a fast and efficient manner thus contributing immensely to the value chain.

Customized products are able to be manufactured as customers can edit the digital design file and send it to the manufacturer for production. Nokia Company has taken the lead in manufacturing in this area by releasing 3D design files of its case to its end users so they can customize it to their specifications and get the case 3D printed.

3.2.8 Domestic Usage

3D printers can be used in the home to make small objects such as ornamental objects such as necklaces and rings. Small plastic toys can also be printed in a domestic setting. In the future, people will be able to print their own products at home instead of buying from shops.

3.2.9 Clothing

The fashion industry has also not been spared. 3D printed clothing is being made. Fashion designers are experimenting with 3D-printed bikinis, shoes, and dresses. Nike made the 2012 Vapor Laser Talon football shoe and New Balance custom-fit shoes for athletes using a 3D prototype. The production was done on a commercial scale

3.2.10 Academia

3D printing is now being integrated in the learning curriculum. With applications from printed molecule models to plastic gears. Students are now able to print their prototype models in 3D and it helps in the learning process of the students. Students are better able to understand concepts as it can be practically shown to them.

IV. BENEFITS

3-D Printing has proven to have the following advantages:

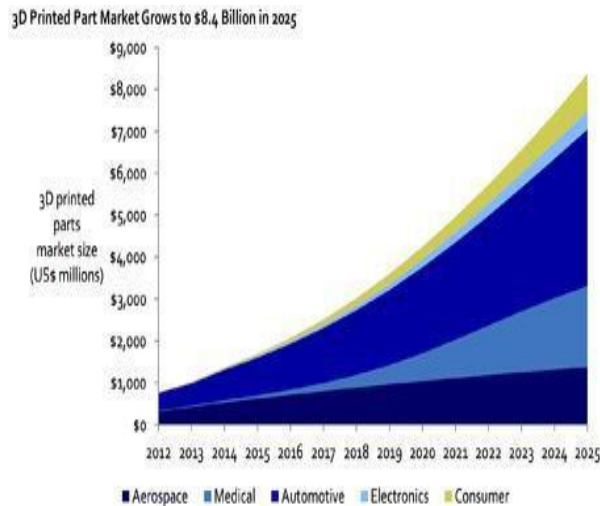
- **Lower Cost:** In China they were able to construct 10 one storey houses at less than \$5000 per house. Construction of a similar house costs way more than the stipulated price.
- **Time:** Printing of the 3D object can be done directly, differing from the traditional manufacturing where you had to join different components to form the final product. Three- dimensional printing allows businesses to construct working models in just hours instead of days or weeks.
- **Efficiency:** Generating prototypes with 3D printers is much easier and faster with 3D printing technology.
- **Flexible:** Different materials can be used in the 3 D models. This makes it very easy to create construction models or prototypes for a wide variety of projects within many industries.
- **Durable products produced:** The objects do not absorb moisture or warp over time making them last for longer.
- **Quality:** Products with an excellent surface finish are produced.
- **Functional Models:** Real live functional models can be produced as opposed to working with paper or digital models. More realistic products are produced.

V. FUTURE WORK

The Future looks bright in the field of 3D printing with the following areas to look out for:

5.1 Manufacturing

The 3D printing industry is set to see unprecedented growth with market analysts predicting a year on year 18 percent growth. As shown in figure 5, it is predicted that the 3D printed part market will grow to an 8.4 billion dollar industry by 2025 [11]. Automobile parts and aerospace will lead in the parts sales forecast.



The combination of Stem cell research and 3D printing will result in transplantable body parts in the future. Real functional body parts will be able to be 3D printed

5.2.2 Skin grafting

In skin grafting healthy skin from a part of the body is used to cover a damaged part of the body. The procedure is very well known to be a painful procedure. University of Toronto researchers have developed a method of skin grafting by loading skin cells and various polymers into a 3D printer to artificially create layers of skin. Institute of Regenerative Medicine scientists at Wake Forest University in Winston- Salem, North Carolina, inspired by war victims aim to print skin directly onto burn wounds. They observed that most of the casualties of war were burn victims who had to go through the gruesome operation of skin grafting. Hopefully in the near future all this research will turn into reality.

5.3 Commerce

Amazon set up a 3D printer store. They envision selling digital 3D design files and the customer then prints the product on their own. This is going to revolutionize the supply side of products as consumers will be able to print whatever products they want

VI. CONCLUSION AND RECOMMENDATIONS

The 3D printing industry is set on a growth trajectory as evidenced by the growth forecasts. The applications of 3D printing are increasing as more and more research is carried out. 3D printing will change the way people acquire products as evidenced by the Amazon proposed model. The field is definitely a game changer with lots of prospects to look out for.

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