

3D Printing

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Abstract: 3D printing as a newly emergent technology, has now been widely considered as the most significant technological breakthrough of the twenty-first century. This paper considers 3D printing as a newly emergent technology and examines its translation into a number of fields. The guardian of authentic material cultures, instead of worrying the widespread of hyper-real reproduction culture caused by 3D printing, showing enthusiastic embracement of this new technology that brings back materiality to the society. This paper thus discusses how 3D printing associates into different fields like apparel, automobile, construction, medical, computers etc. This paper also shows how much beneficial it is to adopt 3D printing instead of using the traditional methods of production and manufacturing.

I. INTRODUCTION

3D printing is any of various processes to make a three-dimensional object. In 3D printing, additive processes are used, in which successive layers of material are laid down under computer control. These objects can be of almost any shape or geometry, and are produced from a 3D model or other electronic data source. A 3D printer is a type of industrial robot.

3D printing in the term's original and technically precise sense refers to processes that sequentially deposit material onto a powder bed with inkjet printer heads. More recently the meaning of the term has expanded to encompass a wider variety of techniques such as extrusion and sinteringbased processes. Technical standards use the term additive manufacturing (AM) for this broader sense.

II. HISTORY

Early AM equipment and materials were developed in the 1980s. In 1981, Hideo Kodama of Nagoya Municipal Industrial Research Institute invented two AM fabricating methods of a three-dimensional plastic model with photo-hardening polymer, where the UV exposure area is controlled by a mask pattern or the scanning fiber transmitter. Then in 1984, Chuck Hull of 3D Systems Corporation, developed a prototype system based on this process known as stereolithography, in which layers are added by curing photopolymers with UV lasers. Hull defined the process as a "system for generating three-dimensional objects by creating a cross-sectional pattern of the object to be formed, but this had been already invented by Kodama. Hull's contribution is the design of STL (STereoLithography) file format widely accepted by 3D

printing software as well as the digital slicing and infill strategies common to many processes today. The term 3D printing originally referred to a process employing standard and custom inkjet print heads. The technology used by most 3D printers to date—especially hobbyist and consumer-oriented models—is fused deposition modelling, a special application of plastic extrusion.

III. APPLICATION

AM technologies found applications starting in the 1980s in product development, data visualization, rapid prototyping, and specialized manufacturing. Their expansion into production (job production, mass production, and distributed manufacturing) has been under development in the decades since. Industrial production roles within the metalworking industrial achieved significant scale for the first time in the early 2010s. Since the start of the 21st century there has been a large growth in the sales of AM machines, and their price has dropped substantially. According to Wohlers Associates, a consultancy, the market for 3D printers and services was worth \$2.2 billion worldwide in 2012, up 29% from 2011. There are many applications for AM technologies, including architecture, construction (AEC), industrial design, automotive, aerospace, military, engineering, dental and medical industries, biotech (human tissue replacement), fashion, footwear, jewelry, eyewear, education, geographic information systems, food, and many other fields.

In 2005, a rapidly expanding hobbyist and home-use market was established with the inauguration of the open-source RepRap and Fab Home projects. Virtually all home-use 3D printers released to-date have their technical roots in the on-going RepRap Project and associated open-source software initiative. In distributed manufacturing, one study has found that 3D printing could become a mass market product enabling consumers to save money associated with purchasing common household objects. For example, instead of going to a store to buy an object made in a factory by injection moulding (such as a measuring cup or a funnel), a person might instead print it at home from a downloaded 3D model.



Fig 1: Model of a turbine showing benefits of 3d printing in industry

IV. INDUSTRIAL APPLICATIONS OF 3D PRINTING

Apparel: 3D printing has spread into the world of clothing with fashion designers experimenting with 3D-printed bikinis, shoes, and dresses. In commercial production Nike is using 3D printing to prototype and manufacture the 2012 Vapour Laser Talon football shoe for players of American football, and New Balance is 3D manufacturing custom-fit shoes for athletes.

3D printing has come to the point where companies are printing consumer grade eyewear with on demand custom fit and styling (although they cannot print the lenses). On demand customization of glasses is possible with rapid prototyping.

Automobiles: In early 2014, the Swedish supercar manufacturer, Koenigsegg, announced the One:1, a supercar that utilises many components that were 3D printed. In the limited run of vehicles Koenigsegg produces, the One:1 has side-mirror internals, air ducts, titanium exhaust components, and even complete turbocharger assemblies that have been 3D printed as part of the manufacturing process.

An American company, Local Motors is working with Oak Ridge National Laboratory and Cincinnati Incorporated to develop large-scale additive manufacturing processes suitable for printing an entire car body. The company plans to print the vehicle live in front of an audience in September 2014 at the International Manufacturing Technology Show. "Produced from a new fiber-reinforced thermoplastic strong enough for use in an automotive application, the chassis and body without drivetrain, wheels and brakes weighs a scant 450 pounds and the completed car is comprised of just 40 components, a number that gets smaller with every revision.

Urbee is the name of the first car in the world car mounted using the technology 3D printing (his bodywork and his car windows were "printed"). Created in 2010 through the partnership between the US engineering group Kor Ecologic and the company Stratasys (manufacturer of printers Stratasys 3D), it is a hybrid vehicle with futuristic look.

Construction: An additional use being developed is building printing, or using 3D printing to build buildings. This could allow faster construction for lower costs, and has been investigated for construction of off-

Earth habitats. For example, the Sinterhab project is researching a lunar base constructed by 3D printing using lunar regolith as a base material. Instead of adding a binding agent to the regolith, researchers are experimenting with microwave sintering to create solid blocks from the raw material.

Medical: 3D printing has been used to print patient specific implant and device for medical use. Successful operations include a titanium pelvis implanted into a British patient, titanium lower jaw transplanted to a Dutch patient, and a plastic tracheal splint for an American infant. The hearing aid and dental industries are expected to be the biggest area of future development using the custom 3D printing technology. In March 2014, surgeons in Swansea used 3D printed parts to rebuild the face of a motorcyclist who had been seriously injured in a road accident. Research is also being conducted on methods to bio-print replacements for lost tissue due to arthritis and cancer.

In October 2014, a five-year-old girl born without fully formed fingers on her left hand became the first child in the UK to have a prosthetic hand made with 3D printing technology. Her hand was designed by US-based Enable, an open source design organisation which uses a network of volunteers to design and make prosthetics mainly for children. The prosthetic hand was based on a plaster cast made by her parents.

Printed prosthetics have been used in rehabilitation of crippled animals. In 2013, a 3D printed foot let a crippled duckling walk again. In 2014 a chihuahua born without front legs was fitted with a harness and wheels created with a 3D printer. 3D printed hermit crab shells let hermit crabs inhabit a new style home.

As of 2012, 3D bio-printing technology has been studied by biotechnology firms and academia for possible use in tissue engineering applications in which organs and body parts are built using inkjet techniques. In this process, layers of living cells are deposited onto a gel medium or sugar matrix and slowly built up to form three-dimensional structures including vascular systems. The first production system for 3D tissue printing was delivered in 2009, based on NovoGen bioprinting technology. Several terms have been used to refer to this field of research: organ printing, bio-printing, body part printing, and computer-aided tissue engineering, among others. The possibility of using 3D tissue printing to create soft tissue architectures for reconstructive surgery is also being explored.

China has committed almost \$500 million towards the establishment of 10 national 3-D printing development institutes. In 2013, Chinese scientists began printing ears, livers and kidneys, with living tissue. Researchers in China have been able to successfully print human organs using specialised 3D bio printers that use living cells instead of plastic. Researchers at Hangzhou Dianzi University actually went as far as inventing their own 3D printer for the complex task, dubbed the "Regenovo" which is a "3D bio printer." XuMingen, Regenovo's developer, said that it takes the printer under an hour to produce either a mini liver sample or a four to five inch ear cartilage

sample. Xu also predicted that fully functional printed organs may be possible within the next ten to twenty years. In the same year, researchers at the University of Hasselt, in Belgium had successfully printed a new jawbone for an 83-year-old Belgian woman. The woman is now able to chew, speak and breathe normally again after a machine printed her a new jawbone.

Computers : 3D printing can be used to make laptops and other computers, including cases, as Novena and VIA OpenBook standard laptop cases. i.e. a Novena motherboard can be bought and be used in a printed VIA OpenBook case.

IV.IMPACT OF 3D-PRINTING

Additive manufacturing, starting with today's infancy period, requires manufacturing firms to be flexible, ever-improving users of all available technologies to remain competitive. Advocates of additive manufacturing also predict that this arc of technological development will counter globalisation , as end users will do much of their own manufacturing rather than engage in trade to buy products from other people and corporations. The real integration of the newer additive technologies into commercial production, however, is more a matter of complementing traditional subtractive methods rather than displacing them entirely.

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