Views | 3D printing can revolutionize the future

Leslie D’Monte

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A couple of weeks back, when an 83-year-old woman became the first person to get a 3D printer-created jaw, it simply took forward the 3D printing story that has been around for around a decade but has been making waves for the last two years.

Made from titanium powder, heated and built-up in layers in a 3D printer, the lower jaw of the woman was given a bioceramic coating. The implant was designed and built by LayerWise—a Belgian metal parts manufacturer which maintains that 3D printing could reduce costs of medical treatment, since operations would be quicker and recovery time shorter.

It was only last July that engineers at the University of Southampton emulated the Wright brothers and printed an aircraft. The engineers, according to an institute release, designed and flew the world’s first ‘printed’ aircraft, “which could revolutionise the economics of aircraft design”. The Southampton University Laser Sintered Aircraft (SULSA) plane is an unmanned aerial vehicle (UAV) whose entire structure has been printed, including the wings, integral control surfaces and access hatches. SULSA is part of the EPSRC-funded DECODE project, which is
employing the use of manufacturing techniques such as laser sintering, to demonstrate their use in the design of UAVs.

The aircraft was printed on an EOS EOSINT P730 nylon laser sintering machine, which fabricates plastic or metal objects, building the item layer by layer. No fasteners were used and all equipment was attached using ‘snap fit’ techniques so that the aircraft could be assembled without tools in minutes. The electric-powered aircraft, with a two-metre wingspan, has a top speed of nearly 100 miles per hour. However, it’s almost silent when in cruise mode, said the release.

Laser sintering allows designers to create shapes and structures that would normally involve expensive traditional manufacturing techniques. The technology allows a highly-tailored aircraft to be developed from concept to first flight in days. Using conventional materials and manufacturing techniques, such as composites, this would normally take months. Furthermore, because no tooling is required for manufacturing, radical changes to the shape and scale of the aircraft can be made at no extra cost.

Fabbers, or personal manufacturing machines (3D printers come under this category), are expected to change the way we live. They resemble microwave ovens but, in fact, 3D printers not only make jewellery, toothbrushes, complex machine components and medical implants, but football boots, racing-car parts and custom-designed cakes as well.

Engineers and designers have been using 3D printers for more than a decade, but mostly to make prototypes quickly and cheap. In India, DesignTech Systems, a distributor of Stratasys Inc, had launched uPrint – a personal 3D printer – priced at $14,900 in June 2009. Wohlers research suggests that over 20 per cent of 3D printers’ output are now final products rather than prototypes and the figure is expected to rise to 50% by 2020.

3D printers fabricate complex objects by depositing materials, layer by layer. They use an additive process (make objects by systematically depositing a chosen raw material in layers). The most common household 3D printing process involves a ‘print head’ that works with any material that can be extruded or squirted through a nozzle.

Another common type uses a laser beam or glue to selectively fuse powdered plastic, metal or ceramic in layers. A user can select an electronic design blueprint and load the raw materials into the 3D printer. The machine does the rest. In a process that can take several hours to days.

At Cornell University, for instance, engineering students with no culinary training used their lab’s 3D printer to fabricate custom-designed cakes which, when cut open, revealed a letter ‘C’. Cornell’s 3D food printer isn’t commercially available as yet.

3D printers typically use plastic, but some high-end machines are able to work with metals and ceramics too. Known as personal manufacturing machines or ‘fabbers’, industrial-size 3D printers cost up to half-a-million dollars, while low-end personal-scale 3D printers cost less than $1,000. Today’s lowest-cost 3D printers have their roots in the University of Bath’s 3D printer called RepRap and Cornell’s Fab@Home project. The blueprints for both are available free to anyone who wants to build his/her own machine or improve upon existing designs — even commercially.

Hod Lipson, an associate professor at Cornell University, who authored a report commissioned by the US Office of Science and Technology Policy titled Factory@Home, told reporters at the American Association for the Advancement of Science (AAAS) event held in Washington DC early this year: “People with no special training can rip, mix and burn physical objects like custom machine parts, household goods, jewellery, and maybe someday, electronic devices.”

Going forward, lack of human imagination appears to be the only limitation for 3D printers. The Fab@Home team at Cornell, for instance, is pursuing the ability to manufacture, on a single 3D printer machine in a single “print job” — a robot. Lipson tickles one’s imagination with his vision of an “...assembly line of computer-guided, 3D printers giving ‘birth’ to baby robots that crawl out of the printer and wander off to a nearby nursery where they learn to use their arms and legs according to instructions already hard-wired into their electronic circuitry.”

NASA is exploring the role of 3D printers as an integral tool for space exploration missions to manufacture machines that can print their own replacement parts and are versatile enough to use a
wide variety of materials available on site. The factories of the future, meanwhile, are expected to have 3D printers working alongside milling machines, presses, foundries and plastic injection-moulding equipment.

In the US, universities, including Standford, Massachusetts Institute of Technology (MIT) and Cornell, have integrated personal fabrication technologies into their science and engineering curricula. The Defense Advanced Research Projects Agency (DARPA), too, has launched a Manufacturing Experimentation and Outreach (MENTOR) initiative to deploy digital manufacturing equipment, including 3D printers, in public high schools.

Tech visionary Ray Kurzweil, according to a Forbes article, predicts that 3D printers will eventually be able to self-replicate by printing the parts to build other 3D printers. A team at Kurzweil’s Singularity University is working on the concept of 3D-printable buildings. Scientists hope to be able to print human tissue and organs as well as bones, but admit that day is some way off.

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