4.1. 3D Printing

There is a great revolution in printing techniques ranging from hybrid printing, nano scale printing, micro dispensing to 3D printing for use in various industries. Over the past couple of years, there have been significant advancements in technology. Currently, the use of artificial intelligence robots cloud-based technology drones and voice assistance are the recent technological trends.

The most popular form of printing technology which you will come across today is 3D printing i.e. Three Dimension printing. The very first commercial 3D printer was based on 'stereo lithography' technique. This was invented by Charles Hull in 1984. 3D printing was launched a couple of years ago, but it is estimated that by the year 2020 it will be generating a large revenue in the market. 3D printing enables you to produce complex shapes using less material than traditional manufacturing methods.

The creation of a 3D printed object is achieved using additive processes. In an additive process an object is created by laying down successive layers of material until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.

3D printing encompasses many forms of technologies and materials as 3D printing is being used in almost all industries. A few examples are dental products, eyewear, architectural scale models, prosthetics, reconstructing bones and body parts in forensic pathology etc

Do it yourself

Find out the 3D objects developed using 3D printer.
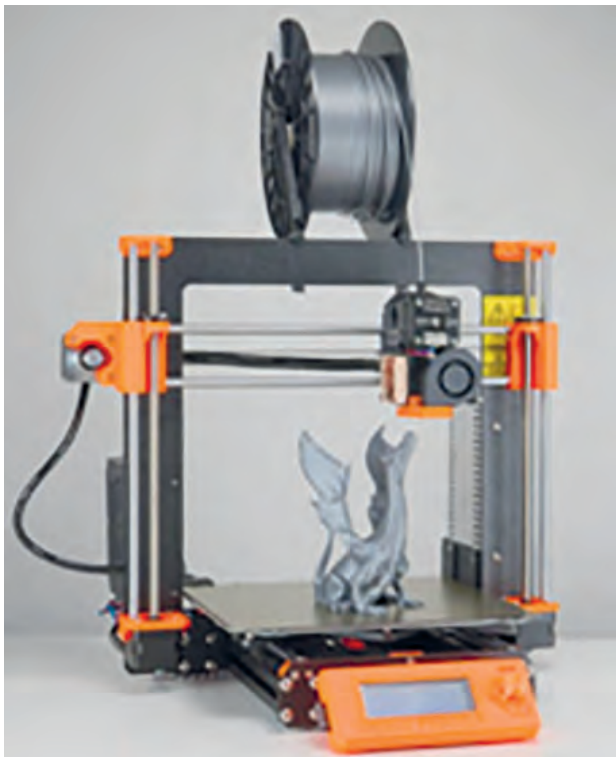
Working of 3D printing

3D printing is a fundamentally different way of producing parts compared to traditional printing. In 3D printing, no special tools are required (for example, a cutting tool with certain geometry or a mold). Instead the part is manufactured directly onto the built platform layer-by-layer, which leads to a unique set of benefits and limitations.

Fig. 4.1 : 3D Printing

Types of 3D Printers

1. Desktop FDM (Fused Deposition Modeling) printers melt plastic filaments and lay it down onto the print platform through a nozzle (like a high-precision, computer-controlled glue gun).

Fig. 4.2 : Working of 3D Printing

2. Large industrial SLS (Selective Laser Sintering) machines use a laser to melt thin layers of metal or plastic powders

Steps Involved in 3D Printing :

1. **CAD File Development :** In order to produce a 3D object you first have to have its virtual design. This is to be done using the Computer Aided Design (CAD) software with the exact dimensions of the objects.

2. **CAD File Conversions :** Once the CAD file is developed, the next thing one has to consider is converting it into specific file formats. The file formats are specified based on the technology of printing being employed by that particular 3D printer.

3. **Preparing The Printer :** Now that everything about the digital file is ready, you need to make sure the 3D printer is ready as well.

4. **The Building Up :** Once the process has started, it is now all about patience. These printers aren't as faster as the 2D printers. Based on the complexity of the object to be printed, the span of printing varies. Depending on the size of the part and the type of printer, a print usually takes about 4 to 18 hours to complete.

5. **Post Processing Stuff :** Once the entire process is done and the object is ready, make sure you handle it carefully. Any actions in haste could prove to be costly. So right from putting on some gloves to bring the object out of the printer to brushing off any residual powder, everything is to be handled carefully.

Fig. 4.3 : 3D models

4.2. Augmented Reality (AR)

Augmented reality (AR) is an interactive experience of a real-world environment. The objects that reside in the real world are enhanced by computer-generated perceptual information, including visuals, auditories and haptics. AR can be defined as a system that fulfills three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects.

The hardware components for augmented reality are: a processor, display, sensors and input devices. Modern mobile computing devices like smartphones and tablet computers contain these elements, which often include a camera and Micro Electro Mechanical Systems (MEMS) sensors such as an accelerometer, GPS, (Geographical Positioning System) and solid state compass, making them suitable AR platforms. There are two technologies used in augmented reality: diffractive waveguides and reflective waveguides.

AR enabled Eyeglasses :

AR displays can be rendered on devices resembling eyeglasses. Versions include eyewear that employs cameras to intercept the real world view and re-display its augmented view through the eyepieces and devices in which the AR imagery is projected through or reflected off the surfaces of the eyewear lens pieces.

Fig. 4.4 : Person using virtual reality headset

Applications :

- **STEM (Science, Tenhnology, Engineering, Mathematics) education :** In educational settings, AR has been used to complement a standard curriculum. Text, graphics, video and audio may be superimposed into a student's real-time environment. Textbooks, flashcards and other

educational reading material may contain embedded "markers" or triggers that, when scanned by an AR device, produced supplementary information to the student rendered in a multimedia format.

- **Visual art :** AR applied in the visual arts allows objects or places to trigger artistic multidimensional experiences and interpretations of reality.

- **Video games :** The gaming industry embraced AR technology. A number of games were developed for prepared indoor environments, such as AR air hockey, Titans of Space, collaborative combat against virtual enemies, and AR-enhanced pool table games.

- **Industrial design :** AR allows industrial designers to experience a product's design and operation before completion.

- **Tourism and sightseeing :** Travelers may use AR to access real-time informational displays regarding a location, its features, and comments or content provided by previous visitors. Advanced AR applications include simulations of historical events, places and objects rendered into the landscape.

- **Translation :** AR systems such as Word Lens can interpret the foreign text on signs and menus and, in a user's augmented view, re-display the text in the user's language. Spoken words of a foreign language can be translated and displayed in a user's view as printed subtitles.

4.3. Virtual reality(VR)

Virtual Reality (VR) is the use of computer technology to create a simulated environment.

The term "virtual" has been used in the computer sense of "not physically existing but made to appear by software" since 1959. One method by which virtual reality can be realized is simulation-based virtual reality. Driving simulators, for example, give the driver on board the impression of actually driving an actual vehicle by predicting vehicular motion caused by driver input and feeding back corresponding visual, motion and audio feedback to the driver.

Fig. 4.5 : Image Of Virtual reality headset

Modern virtual reality headset displays are based on technology developed for smartphones including: gyroscopes and motion sensors for tracking head, hand and body positions; small HD screens for stereoscopic displays; and small, lightweight and fast computer processors.

Special input devices are required for

interaction with the virtual world. These include the 3D mouse, the wired glove, motion controllers, and optical tracking sensors. Controllers typically use optical tracking systems (primarily infrared cameras) for location and navigation, so that the user can move freely without wiring. Some input devices provide the user with force feedback to the hands or other parts of the body, so that the human being can orient himself in the three-dimensional world through haptics and sensor technology as a further sensory sensation and carry out realistic simulations.

Virtual reality cameras can be used to create VR photography using 360-degree panorama videos. 360-degree camera shots can be mixed with virtual elements to merge reality and fiction through special effects. Example google 3D Maps.

Applications :

1. Virtual reality is most commonly used in entertainment applications such as video gaming and 3D cinema.

2. Digital marketing and E-commerce.

3. Gaming industries.

Difference between AR And VR :

Augmented reality (AR) adds digital elements to a live view often by using the camera on a smartphone. Examples of augmented reality experiences include Snapchat lenses and the game Pokemon Go.

Virtual reality (VR) implies a complete immersion experience that shuts out the physical world. Using VR devices such as HTC Vive, Oculus Rift or Google Cardboard, users can be transported into a number of real-world and imagined environments such as the middle of a squawking penguin colony or even the back of a dragon.

Do it yourSelf

Find applications of AR and VR.

4.4. Fifth Generation (5G) :

5G is the fifth generation of cellular network technology.

5G is the next generation of wireless communications. It is expected to provide Internet connections that are least 40 times faster than 4G LTE. 5G technology may use a variety of spectrum bands, including millimeter wave (mmWave) radio spectrum, which can carry very large amounts of data a short distance. The drawback of the higher frequencies is that they are more easily obstructed by the walls of buildings, trees and other foliage and even inclement weather.

Millimeter wave: Millimeter waves are broadcasted at frequencies between 30 GHz and 300 GHz, compared with the bands below 6 GHz used for 4G LTE. The new 5G networks will be able to transmit very large amounts of data—but only a few blocks at a time. 5G networks are digital cellular networks, in which the service area covered by providers is divided into small geographical areas called cells. Analog signals representing

sounds and images are digitized in the telephone, converted by an analog to digital converter and transmitted as a stream of bits. All the 5G wireless devices in a cell communicate by radio waves with a local antenna array and low power automated transceiver (transmitter and receiver) in the cell, over frequency channels assigned by the transceiver from a pool of frequencies that are reused in other cells. The local antennas are connected with the telephone network and the Internet by a high bandwidth optical fiber or wireless backhaul connection. As in other cell networks, a mobile device crossing from one cell to another is automatically "handed off" seamlessly to the new cell.

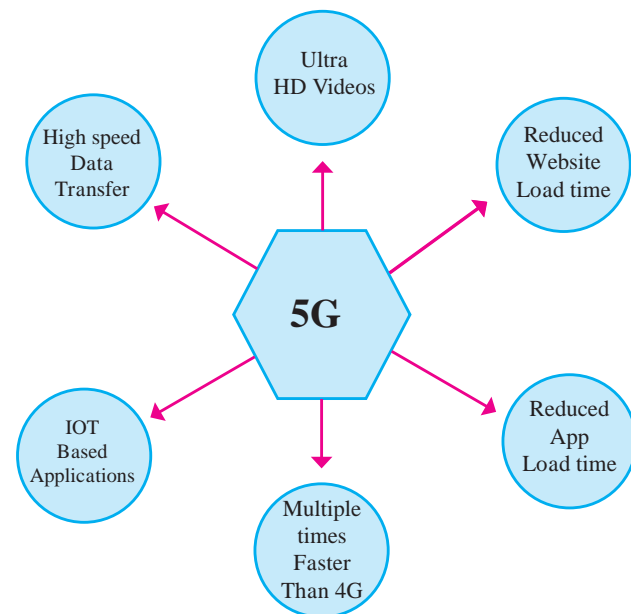5G can support up to a million devices per square kilometer, while 4G supports only up to 100,000 devices per square kilometer.

Applications :

1) Online 5G Games.

2) Automated Vehicles.

3) Virtual Classrooms.

Features of 5G are shown in fig. 4.6

Features of 5G

Fig. 4.6 : Features of 5G

Do it yourself

Find out various technologies used in smart cities.

Summary

○ 3D printing is the fastest method of making prototype models.

○ 3D printing plays very important role in the fields of medical, art and science.

○ AR Stands for Augmented Reality.

○ VR stands for virtual Reality.

○ 5G is the 5th generation of mobile communication technology.

○ 5G is the fastest method of data transfer.

Q.1 Fill in the blank.

1. FDM technique is used for...............

2. With the help of 3D printing, we can create .... models.

3. AR stands for............................

4. VR stands for ....

5. The 5th Generation of mobile communication technology is also known as..............................

Q.2 Match the pair.

'A'	'B'
1) F.D.M. Technique	a) 5G
2) Fastest method of data transfer	b) VR
3) Augmented Reality	c) 3D Printing
4) Virtual Reality	d) AR

Q.3 State whether the given statement are true or false.

1. FDM is the type of 3D printing Technology.

2. 3D gaming is an application of VR

3. 5G is 100 times Faster than 4G.

4. Ultra HD videos can be played at Faster rate by using 5G.

Q.4 Write short Answers.

1. Explain 3D Printing Technology.

2. Give some Applications of 3D Printing technology.

3. Explain Augmented Reality.

4. Explain Virtual Reality.

5. Explain Concept of 5G.

6. List some Features of 5G.