

## **Unit V: Future Trends**

### **# Augmented reality (AR)**

AR is an interactive experience of a real-world environment where AR combines the physical world with computer-generated virtual elements overlay. These 2D or 3D virtual content are projected in reality within people's field of view (through smartphone camera or smartglasses).

Augmented reality is a technology that virtually places a 2D/3D visual into a "real-world" experience. This gives the user the appearance that the virtual object is co-existing with them in the physical world.

In a few words, AR is the real world with an added layer of virtual content (2D/3D).

### **Applications or Use Cases for AR**

#### **1. Medical Training**

From operating MRI equipment to performing complex surgeries, AR tech holds the potential to boost the depth and effectiveness of medical training in many areas: for example, will now learn anatomy utilizing an AR headset allowing them to delve into the human body in an interactive 3D format.

#### **2. Retail**

In today's physical retail environment, shoppers are using their smartphones more than ever to compare prices or look up additional information on products they're browsing. Users can view a motorcycle they might be interesting in buying in the showroom, and customize it using the app to see which colors and features they might like.

#### **3. Repair & Maintenance**

One of the biggest industrial use cases of AR is for repair and maintenance of complex equipment. Whether it's a car motor or an MRI machine, repair and maintenance staff are beginning to use AR headsets and glasses while they perform their jobs to provide them with useful information on the spot, suggest potential fixes, and point out potential trouble areas.

#### **4. Design & Modeling**

From interior design to architecture and construction, AR is helping professionals visualize their final products during the creative process. Use of headsets enables architects, engineers, and design professionals step directly into their buildings and spaces to see how their designs might look, and even make virtual on the spot changes.

#### **5. Business Logistics**

Some Shipping company had already implemented smart AR glasses in some of its warehouses, where

lenses display to workers the shortest route within a warehouse to locate and pick a certain item that needs to be shipping.

#### **6. Tourism Industry**

AR presents a huge opportunity for travel brands and agents to give potential tourists an even more immersive experience before they travel. Imagine taking a virtual "Walkabout" Australia before on AR glasses before booking a ticket to Sydney, or a leisurely stroll around Paris to see what museums or cafes you might like to visit. AR promises to make selling trips, travel, and vacations a whole lot easier in the future.

#### **7. Classroom Education**

For Example, Students can learn about astronomy ny using AR glasses to see a full map of the solar system, or those in a music class might be able to see musical notes in real time as they learn to play an instrument.

#### **8. Field Service**

Today, the technicians can arrive on-site with AR glasses or headsets and view whatever they're repairing to more quickly diagnose - and fix - the problem. And instead of having to thumb through a repair manual, technicians can go about their business hands-free to get in and out faster than ever.

#### **9. Entertainment Properties**

In the entertainment industry, it's all about building a strong relationship with your branded characters and the audience. "Pokemon Go!" still has its die-hard fans. But the main part of this game's appeal was the way it combined the real world with favorite Pokemon characters.

### **Disadvantages of AR**

1. It is very expensive to implemented and develop **AR** technology based projects and to maintain it.
2. It is very costly to develop **AR** enabled devices.
3. Lack of privacy is major drawback of **AR**.
4. Low performance level of **AR** devices is a major drawback which can be arise during testing phase.

### **# Virtual Reality (VR)**

Virtual reality (VR) refers to a computer-generated simulation in which a person can interact within an artificial 3D environment using electronic devices, such as special goggles with a screen or gloves fitted with sensors. In this simulated artificial environment, the user is able to have a realistic-feeling experience.

It uses software to produce images, sounds, and other sensations to create a different place so that a user feels like he or she is really part of this other place.

## Applications or Use Cases for VR

### 1. VR in Military

The military in the UK and the US have both adopted the use of virtual reality in their training as it allows them to undertake a huge range of simulations. VR can transport a trainee into a number of different situations, places and environments for a range of training purposes. The military uses it for flight simulations, battlefield simulations, medic training, vehicle simulation and virtual boot camp, among other things.

### 2. VR in Sport

Virtual reality can be used by coaches and players to train more efficiently across a range of sports, as they are able to watch and experience certain situations repeatedly and can improve each time. Essentially, it's used as a training aid to help measure athletic performance and analyse technique.

### 3. VR in Mental Health

For example, some patients with anxiety find meditating using VR to be an effective method to manage stress reactivity and boost coping mechanisms. Virtual reality technology can provide a safe environment for patients to come into contact with things they fear, whilst remaining in a controlled and safe environment. This is just one of the ways virtual reality can have a real positive impact on society.

### 4. VR in Medical Training

Due to its interactive nature, medical and dental students have begun using VR to practice surgeries and procedures, allowing for a consequence free learning environment; the risk of inflicting harm or making a mistake while practicing on real patients is eliminated. Virtual patients are used to allow students to develop skills which can later be applied in the real world.

### 5. VR in Education

Students are able to interact with each other and within a 3D environment. They can also be taken on virtual field trips, for example, to museums, taking tours of the solar system and going back in time to different eras. Technology company, Floreo, has developed virtual reality scenarios that allow children to learn and practice skills such as pointing, making eye contact and building social connections. Parents can also follow along and interact by using a linked tablet.

### 6. VR in Fashion

For example, virtual simulations of store environments can be extremely useful for retailers to design their signage and product displays without fully committing to the build like you would in the real world. In the same way, appropriate time and resources can be allocated for the build of the store layout.

### 7. Virtual tours and real-time product demos

One of the most useful ways to convince a customer to buy a product is to allow them to use it in real-time to experience using it – see how it looks and works.

From manufacturing and packaging to interior design, businesses can use VR to give consumers a demo of the product, to understand better what goes into making it.

## Disadvantages of VR

1. Lack Of Flexibility.
2. Functionality Issues.
3. Addiction To The **Virtual** World.
4. Quite Expensive.
5. Reduces connections with humans.

| AR   | VR  |
|--|---|
| The system augments the real-world scene   | Completely immersive virtual environment  |
| In AR User always have a sense of presence in the real world   | In VR, visual senses are under control of the system  |
| AR is 25% virtual and 75% real   | VR is 75% virtual and 25% real  |
| AR requires upwards of 100 Mbps bandwidth  | VR requires at least a 50 Mbps connection   |
| No AR headset is needed.   | Some VR headset device is needed.   |
| With AR, end-users are still in touch with the real world while interacting with virtual objects nearer to them. | By using VR technology, VR user is isolated from the real world and immerses himself in a completely fictional world. |
| It is used to enhance both real and virtual worlds.  | It is used to enhance fictional reality for the gaming world.   |

## # Mixed Reality (MR)

**MR** is the merging of real and virtual worlds to produce new environments and visualizations, where physical and digital objects co-exist and interact in real time. Mixed reality is a hybrid of reality and virtual reality. There are many practical applications of mixed reality, including entertainment, military training, and remote working.

## # 1G, 2G, 3G, 4G & 5G

### 1G: First Generation

These are the analog telecommunications standards that were introduced in the 1980s and continued until being replaced by 2G digital telecommunications. The maximum speed of 1G is **2.4 Kbps**.

### 2G: Second Generation

It is based on GSM. The radio signals used by the 1G network were analog, while 2G networks were digital. During 2G, Cellular phones were used for data along with voice.

- Data speeds of up to **64 kbps**
- Use of digital signals instead of analog.
- Enabled services such as SMS and MMS
- Provided better quality voice calls
- It used a bandwidth of 30 to 200 KHz

### 3G: Third Generation

3G network combines aspects of the 2G network with new technologies and protocols to deliver a significantly faster data rate. By using packet switching, the original technology was improved to allow speeds up to **14 Mbps**. It operates at a range of 2100MHz and has a bandwidth of 15-20MHz. Some of the main features of 3G are:

- Speed of up to **2 Mbps**
- Increased bandwidth and data transfer rates
- Send/receive large email messages
- Large capacities and broadband capabilities

### 4G: Fourth Generation

The main difference between 3G and 4G is the data rate. There is also a huge difference between 3G and 4G technology. The key technologies that have made 4G possible are MIMO (Multiple Input Multiple Output) and OFDM. The most important 4G standards are WiMAX and LTE. While 4G LTE is a major improvement over 3G speeds, it is technically not 4G. 4G designed to provide IP-based voice, data and multimedia streaming at speeds of at least **100 Mbps** and up to as fast as **1 Gbps**.

## # 5G: Fifth Generation, History & Objectives

**History:** On April 3, 2019, South Korea became the first country to adopt 5G.

Just hours later, Verizon launched its 5G services in the United States.

South Korea's 5G service was launched initially for just six South Korean celebrities.

In June 2019, the Philippines became the first country in Southeast Asia to roll out a 5G network.

### Objectives of 5G:

- ✓ Improve bandwidth
- ✓ Enhance download and upload speeds
- ✓ Efficiency and lower levels of latency
- ✓ Opportunity for other technologies to penetrate the market.
- ✓ Better connectivity between IoTs.
- ✓ More Reliability
- ✓ Massive network capacity
- ✓ Higher performance

## # 5G technology and how is it different?

5G is the latest upgrade in the long-term evolution (LTE) mobile broadband networks. 5G mainly works in 3 bands.

**1. Low band spectrum:** It has shown great promise in terms of coverage and speed of internet and data exchange, the maximum speed is limited to 100 Mbps.

**2. Mid band spectrum:** It offers higher speeds compared to the low band, but has limitations in terms of coverage area. This spectrum doesn't penetrate buildings very well, but it does deliver speeds around 1 Gbps.

**3. High band spectrum:** It offers the highest speed of all the three bands, but has extremely limited coverage and signal penetration strength. Internet speeds in the high-band spectrum of 5G has been tested to be as high as 20 Gbps. While in most cases, the maximum internet data speed in 4G has been recorded at 1 Gbps.

## # Global scenario of 5G Telecom?

Global telecom companies have started building 5G networks and rolling it out to their customers on a trial basis.

**1. US:** companies such as AT&T, T-mobile, and Verizon have taken the lead when it comes to rolling out commercial 5G for their users.

While some such as AT&T had started testing and deploying the technology as early as 2018, other companies such as Verizon have followed suit, expanding their 5G ultra-wide broadband services to as many as 60 cities by the end of 2020.

**2. China:** Some of the telcos such as China Unicom had started 5G trials as early as 2018, and have since rolled out the commercial services for users.

**3. South Korea:** On April 3, 2019, South Korea became the first country to adopt 5G. The country has rolled out 5G to 85 cities as of Jan. 2020. Government officials estimate 90% of Korea's mobile users will be on a 5G network by 2026.

South Korean company Samsung, which had started researching on 5G technology way back in 2011. On the other hand, taken the lead when it comes to building the hardware for 5G networks for several companies.

### # 5G in India

In 2018, India had planned to start 5G services as soon as possible.

All the three private telecom players, Jio, Airtel and Vi, have been urging the DoT to lay out a clear road map of spectrum allocation and 5G frequency bands, so that they would be able to plan the roll out of their 5G services.

The telecom department will conduct a spectrum auction in March. Spectrum in the 700MHz, 800MHz, 900MHz, 1,800MHz, 2,100MHz, 2,300MHz and 2,500MHz bands will be on sale, while the 3,300-3,600 bands, which were suggested by the telecom regulator for 5G, are not included in the upcoming sale.

**Reliance Jio:** It is the only profitable telco in India, plans to launch 5G services in the second half of 2021 with its home-grown solution, announced by Mukesh Ambani announced during India Mobile Congress (IMC).

**Bharti Airtel:** Airtel confirmed that its network is fully 5G ready and that it has become the country's first telco to successfully demonstrate live 5G service over a commercial network in Hyderabad city with existing 1800 MHz mid spectrum band through the NSA (non stand alone) network technology.

### # 5G Applications and Use cases

#### 1. Agriculture

Farms of the future will use more data and fewer chemicals. Taking data from sensors located directly in the fields with fast 5G connectivity, farmers can identify with pinpoint precision which areas need water, have a disease, or require pest management.

#### 2. Smart City Applications

Smart Cities with 5G could minimize traffic congestion, improve safety, and make public services more efficient. Smart IoT sensors could potentially transmit data quickly over 5G networks to alert city officials of problems, notify commuters of traffic conditions, or even notify people of open parking spaces.

#### 3. Healthcare

5G healthcare use cases will enable doctors and patients to stay more connected than ever. Wearable devices could alert healthcare providers when a patient is experiencing some serious symptoms. Devices with fast 5G connectivity will automatically alerts the team to be ready for an incoming patient, with a complete record of data collected by the device.

#### 4. Logistics

In shipping and logistics, keeping track of inventory is expensive, slow, and difficult. 5G offers the potential for greater communication among vehicles, as well as between vehicles and infrastructure itself.

#### 5. Manufacturing

Factories will be totally transformed by the convergence of 5G, AI, and IoT. Beyond predictive maintenance that helps control costs and minimize downtime, factories will also use 5G to control and analyze industrial processes with an unprecedented degree of precision.

#### 6. Autonomous Vehicles

Autonomous vehicles are one of the most anticipated 5G applications. 5G will reduce latency, as vehicles will be able to respond 10-100 times faster than over current cellular networks. 5G will also make fast remote diagnostics and OTA updates, predictive maintenance, usage-based auto insurance and more.

#### 7. Augmented Reality (AR) and Virtual Reality (VR)

The low latency of 5G will make AR and VR applications both immersive and far more interactive. In industrial applications, for example, a technician wearing 5G AR goggles could see an overlay of a machine that would identify parts, provide repair instructions, or show parts that are not safe to touch.

#### 8. 5G IoT Applications for Drones

Drones have a vast and growing set of use cases today beyond the consumer use for filming and photography. For example, utilities are using drones today for equipment inspection. Logistics and retail companies are looking at drone delivery of goods. The trend will continue, and together with 5G we will be able to push limits of drones that exist today, especially in range and interactivity.



## # Brain Computer Interface

A brain computer interface (BCI), sometimes called a neural control interface (NCI), mind machine interface (MMI), direct neural interface (DNI), or brain-machine interface (BMI).

BCIs acquire brain signals, analyze them, and translate them into commands that are relayed to output devices that carry out desired actions.

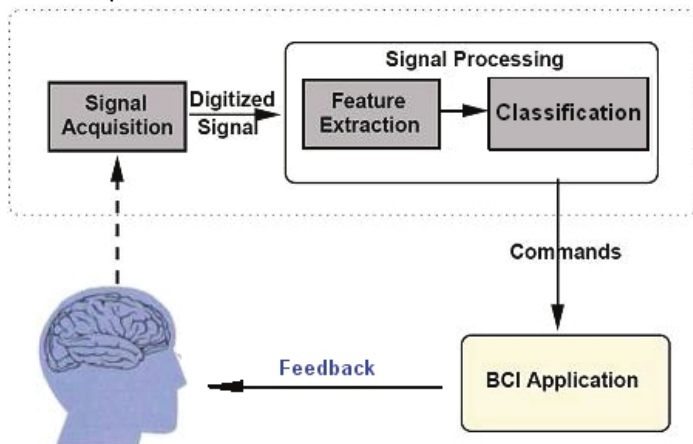
BCIs measure brain activity, extract features from that activity, and convert those features into outputs that replace, restore, enhance, supplement, or improve human functions.

- ✓ BCIs may replace lost functions, such as speaking or moving.
- ✓ They may restore the ability to control the body, such as by stimulating nerves or muscles that move the hand.
- ✓ BCIs have also been used to improve functions, such as training users to improve the remaining function of damaged pathways required to grasp.
- ✓ BCIs can also enhance function, like warning a sleepy driver to wake up.
- ✓ BCIs might supplement the body's natural outputs, such as through a third hand.

## # BCI System: Block Diagram

A BCI system consists of three components

1. Signal or Data Acquisition
2. Signal Processing (Feature Extraction & Translation)
3. Output Device.



### 1. Signal Acquisition

Signal acquisition in a BCI helps in the measurement of brain signals using a sensor modality. The sensor is basically a device implanted in the brain that records the signals. After amplification and filtering process, the signals can be digitized and transmitted to a computer.

### 2. Feature Extraction

Feature extraction in Brain Computer Interface (BCI) is the process of analyzing the digital signals to distinguish signal characteristics and represent them in a compact form suitable for translation into output commands.

### 3. Feature Translation

Resulting signal features are passed to the feature translation algorithm, which converts the features into the commands for the output device (i.e., commands that accomplish the users need).

### 4. Output Device

The commands from the feature translation algorithm operate the external device of the Brain Computer Interface (BCI), providing functions such as cursor control, letter selection, robotic arm operation etc. The device operation then provides feedback to the user finally, thus completing the closed loop of Brain Computer Interface(BCI).

### Advantages of Brain Computer Interface:

- ✓ It allows paralyzed people to control the prosthetic limbs with their mind.
- ✓ Transmit visual images to the mind of a blind person which allows them to see.
- ✓ Transmit auditory data to the mind of a deaf person which allows them to hear.
- ✓ It allows gamers to control the video games with their minds.
- ✓ It allows a mute person to have their thoughts to be displayed and spoken by computer.

### Disadvantages of Brain Computer Interface:

- × BCI research is still at initial stages and not at matured stage.
- × BCIs are currently fairly inaccurate in terms of classifying neural activity.
- × BCIs placed outside of the skull have a limited ability to read brain signals.
- × They can be placed under the skull, but this requires pretty drastic surgery.
- × Reading people's inner thoughts comes with a massive amount of ethical issues.

## # BCI Applications

**1. Gaming:** In this field BCIs could be used in video games. For instance, players could control their avatar using only a BCI.

**2. Lie detection, Brain Fingerprinting, Trust assessment.**

**3. They may restore the ability to control the body, such as by stimulating nerves or muscles that move the hand.**

**4.** BCIs can also enhance function, like warning a sleepy driver to wake up.

**5.** BCIs might supplement the body's natural outputs, such as through a third hand.

**6. Communication & Spelling Devices:** Spelling devices allow severely disabled users to communicate with their environment by sequentially selecting symbols from the alphabet.

**7. Environment Control:** Environment control systems allow to control electrical appliances with a BCI.

**8. Wheelchair Control:** A BCI can potentially be used to steer a wheelchair. Because steering a wheelchair is a complex task and because wheelchair control has to be extremely reliable.

**9. Replace lost functions:** We can use BCI for controlling movement of limbs and to restore motor function. BCIs may replace lost functions, such as speaking or moving.

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