FOUNDATION OF DIGITAL BUSINESS

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Week 01

Lecture 05

Lceture 05 : Overview of Emerging Digital Technologies - Part 3

Good morning, so we continue with our second module, which is an overview of emerging digital technologies. And this is part 3; I have already covered part 2. These are all part of the whole topic, which deals with current emerging technologies. So, one by one. Today we will cover things like augmented reality, virtual reality, 3D printing, and intelligent robots. As I have told in the beginning this is for business.

The course will not be getting into the technical part of all any of these technologies. we will not be getting into the technical part of any of these technologies. We just talk about what it can do so that you can understand where you can use it. The ultimate aim for you in attending this course and learning is to understand where such digital technologies can be applied for the purpose of digitalization. Let me explain again.

So, I am exposing you to certain technologies which are constituents of what we call Industry 4.0, the fourth generation of the industrial revolution. So, we are in the digital age; we are past computers, doing more than just computers and microprocessors, and we are entering an internet-connected world. We will move on to AI which will probably be industry 5.0. At 4.0 these are the digital technologies which are are being deployed in various industrial applications to solve business problems. applications to solve business problems. The purpose of this is to tell you how to use these technologies to solve digital and problems and bring in what are we calling as digital transformation of an industry.

So, going to this technology of virtual reality. So, virtual reality is a computer generated simulation of an alternate world. So, it is using something like your 3D movies and video games where you actually get completely immersed into your environment that is you become part of what you are trying to show. I mean if you are in a cricket match or

wherever or I am taking a class for example, if I use VR technology, I will be seeing as if I am inside the class with all the students. And your virtual presence in the classroom will be seen including mine.

So the teacher plus students everybody is sitting in a virtual classroom. So one of the very common usage what people are contemplating or even trying out it is something called a metaverse. You must heard we will talk about it much later again in a few slides down the line. they are saying that in a virtual world you can have conduct business meetings for example. So, instead of overdoing it over what we do over phones or video calls now you get into a virtual world where you literally see each other.

So, that can give you a complete as if you are sitting across a table. So, that gives you a different feeling altogether and you can have a different level of discussion. So, the idea is to bring the world physical world and merge it with or replace it with a virtual world giving something a very similar feeling or sensation. An example could be like the pilots when they train, they do not train in a real aircraft to begin with.

So, they are trained in something called a simulator. Now, the simulator is a machine and once they sit inside that they get a feeling that they are as if they are actually sitting in the cockpit of a real aircraft and flying the aircraft. So, they will get all those sounds, noises, views, visions, feelings, vibrations everything that happens in a real environment. So, the purpose is to as I have been telling you to convert the real environment into a virtual environment. So, that is why we call it virtual, but reality.

So, it is a real world and but depicted virtually. One of the examples stated is that Ford Motor Company are using VR to design vehicles. In the same way you can virtually sit inside a car and you are designing the car. So, that you it does it performs the way you want it to perform as per the new design. Or say the medical students they do the body dissection to learn inside whatever organs etc. So, unless you cut a body they will not be able to see that.

Currently, unclaimed bodies are sent to hospitals or the medical colleges such that students can use them for their education purpose. But now it is getting gradually replaced with this. So, that you do not no longer need physical actual human bodies, but you can be replaced by a virtual human body. So, where everything has been digitized. So, you see the organs as they are they should be in a realistic mode. Now, talking about augmented reality.

like you are holding a device as you see in the picture and you see a sofa set and then you can add more features to that which you want to show. This is an augmented reality which means the reality is there and you are taking a picture or a video and then you are augmenting it. So, physically there is only one sofa, but I can change the colors for example. Suppose the background of the room is blue then what should be the color of my sofa ideally be best matching blue, but what shade of blue. or if I change the background if I know my house is actually has got a white wall or a brown wall.

I can change the colour of the upholstery of the sofa virtually and see the effect. Then I can take a decision and tell the supplier that I want this sofa, with different upholstery colour . So, this that is the virtual part of it that you are changing the colour. of the sofa. Now if you take a scenario which many of you are using nowadays where maps and real scenarios of a town or a new place you are visiting and you want to find out those things can be presented in this map, the digital map.

So, it is a digitally enhanced map where you can find out various things. Another example I can give you is if all of you must be seeing cricket matches, IPL, T20 matches, IPL tournament etc. Now when you watch the match from your room, from your house on a TV and a person who is watching the match in the stadium. They get two different views, I am talking real time live television. You can see many advertisements placed on the field itself like MRF tyre or Pepsi. You can see them on the field as if they are painted.

The person on the ground actually watching the match in the real stadium does not see any of this because the ground the grass is green and the pitch is whatever the pitch should be. This is an example of augmented reality because somebody is taking a video real time and then adding digital components features like other visuals and you are seeing a combination of the real video the real match which is going on and then augmented with some other visuals which are depicting an ad or whatever or maybe an information also could be depicted like that. So, this is another good example of augmented reality. Use case of AI technologies will be in the domain of medical, science, entertainment, military training, engineering, design, robotics, manufacturing, maintenance and hazard detection.

You can go on talking in each of these where it can be used, you can find out from internet and find out say search by applications of AI technology in say manufacturing industry. and you will get lot of many use cases because these are now being used quite

heavily. But virtual reality will take some time because the gadgets and equipments are expensive, the goggles, the vision, etc. lens they are not cheap and it needs lot of IT support, backbone computation. So, virtual reality or metaverse they are slowly picking up, but not fast enough, but AR is more less much more less technology heavy.

So, you can they are being used and not so expensive, so the usage of AR is much more In virtual reality architecture, urban designs, industrial design, restorative nature expenses, healthcare and medical systems. Then you have this surgery, you can do medical surgery, maintenance in hazardous industries. This one I had seen of a petrochemical industry using VR for the training purposes. I have been to an oil company and they were showing me the VR app and how they use this for training. And there are lot of pipelines very complex.

So, you can move around the entire, I put on that lens and I was actually travelling moving inside the refinery between equipments, between the storage tanks, pipelines, valves. So, I was getting a feeling as if I am actually inside the refinery. So, and then you know then of course they have for the training purpose obviously they will be giving lot of lecture classes and background audio and other information. So, that the student or the trainees can learn what is going on there, but I was just of course taking only a demo. Other things are digital marketing, education training, oil refinery. We were talking about nuclear plants, power plants or any chemical industry use VR for there training purposes.

engineering, robotics, entertainment, video games, tourism etc. So, you can see host of industries have a very good potential of using virtual reality and tourism is another thing which people are talking about this is called virtual tourism. So, you put on that as if you are physically visiting wherever, maybe you can climb Mount Everest for example, get that feeling of how it feels, looks etc. And travelling places people are actually using it is called virtual tourism, you can go to Japan etc. So, you do not obviously spend so much money, but you can get a flavour.

It will never be equal to physical tourism, physically going and climbing Everest and virtually doing it, there is a hell of a difference, but at least you can get something, some feeling etc. at a much much lower cost than the actual thing. So, here you can see the salesman is trying to sell various features of the automobile. So, you can get various views from top, bottom, inside etcetera. Even the car may not be there actually physically in the showroom, but you can come to know what is all their features etcetera in the car.

This is what is there took in using in the design engineering reviews. This is for travelling etcetera and this is if you are designing for example, a house or a room you can use virtual reality. And you can fit in things and see how it looks in that environment virtually and then you can of course order. So, if you assuming say you got get into IKEA shop and you want to order furniture for your new house. IKEA can take you to their VR lab and then go on showing you various things and you bring the picture of your house which they put it on the virtual video and then add those things there.

So, it is definitely you are bringing two things together your house, the video into the Ikea shop and the Ikea is adding the various furniture equipment. So, you are matching the two and then getting the best result out of it. Otherwise you will have to imagine my flat room, drawing room looks like this, bedroom looks like this etcetera. So, everything is already at best you can bring some pictures, but putting in a real video will give you much more better you know judgment. Now moving on to 3D printing. 3D printing is also known as additive printing. Here it is three-dimensional in the sense you can now build thickness.

In making a three-dimensional object, it can be various things from a machine parts to toys etcetera to the extent now we are building 3D houses and in India we have started printing 3D houses. So, I will show you a picture. The primary advantage of this technique is its ability to create almost any shape or geometric feature. Even from remote, if you need a maintenance parts ,e.g. in the International Space Station, which is 250 kilometers above the earth's level. Something has broken e.g. the door handle some plastic. And they have a 3D printer in there making plastic components.

So, you doing the design here sitting in the world in NASA center or somewhere, you send the design. to the computer there in the ISS through radio waves or whatever and it is connected to a 3D printer and it can print out exactly what you want. So, you can get things done much faster as you can understand I can get it done in 2 days, 3 days or 1 day time. For the ISS the next rocket will come maybe after 6 months and you have to wait to get that spare. But with 3D printing you can get the spare made, when required . So, if people are imagining like if you want to bring a set up a habitation in moon for example.

So how do we send everything? So instead of sending everything why do not you put lot of printers 3D printers and get things printed there with material whatever is available etc. So that is another set of imagination is which is going on that can we build housing colonies in moon using 3D printers instead of carrying everything. So like this you can

see an object an engineering looks like an engine. component very complex, very intricate.

Now making this by casting process what we are doing is possible, but using 3D printing it is much easier, better, faster. and could be cheaper also. Let us say prosthetic component part like your hand or knees for physically injured or disabled person where for a missing hand, you have to replace with a prosthetic arm. And of course, it will have other features like it can move and all that control etcetera, but just making this complex thing is this is done by 3D printing. Or if you see the house here and you can see some people standing here you know that this is a theater. It has been built in China and if you are following news recent in India

And I think few days back I saw somewhere another house being built 3D printed and the advantage is they can be built very fast. I mean in China they have been building houses in 2 days, 3 days, 4 days, so obviously the cost your entire labour cost reduces as these are all automated machines and you can use those machines and save time and get a house built. So, the application areas of 3D printing are medical, food, toys, fashion, engineering, space, defense. Now you might be wondering what is food doing here.

Let me see I think I have a slide here. So, here they are printing burgers. I have seen, I do not have the picture here, in Israel they have tried out printing meat, 3D printed meat. So, meat is printed out of some synthetic material, organic material which tastes like meat and you can print it like a steak or some shape, give some shape on a 3D printer. and then cook it and it is being used and it is commercially being made even they are trying to make some kind of fish or whatever all food products.

Like the next thing which people are really looking for is 3D printing body parts and they have actually tried out printing eye cornea or lips or even skin. So, there is a saying that in some years time probably we will not know whatever component inside gets damaged kidney we can get replaced by a 3D printed kidney. So, you do not need a real donor which is the biggest problem and there is huge demand of kidney replacement and you do not get donors, but if you can 3D print out of So, some organic chemicals that could be one of the ideal solution it will solve a huge problem of this acute shortage of kidney replacement that is a huge demand. It is true with say things like liver and other things etcetera which can be probably replaced. We do not when and it could be 5 years or 10 years, but many people are working on it.

So, this is, you know, I can see the processing of the complex. You can see how the complexity of the design has been made through just printing like this computer printing the arm. And this is the house. This is the concrete which is being, you know, not sprayed really, but like a printer head, it is adding layer by layer by layer. You can see those layers. So, that is why it is called additive printing or additive manufacturing. You are adding layer by layer by layer. So, each layer is how you are building the height, the third dimension. Yeah, this is that picture of the first 3D printed post office in Bangalore.

This is a real post office which has been built using 3D printing. On the surface texture, you can make out how it has been built layer by layer by layer. So, you can see those various layers of how the cement has been added and the house was gradually built. Because of the intricate shapes, you can have these windows, etcetera, gaps. they would not be there. They will jump again, spray on, and put on the next move. So, the windows are also created during the printing process itself, not that they are cut out later, etcetera.

they are actually when they are printing, they will have those gaps so that you get all those shapes. Like this is a 3D printed car, for example. So, people are trying out all sorts of things with 3D printing. This may not be a commercial vehicle, but people are still trying out to see the strength or potential of this technology. What is its limit? What can it achieve?

What can it do? So, that is why people are trying out various interesting and funny things. So, with these technologies, what we see is the end-to-end computer network of today. So, we have all these technologies here, and then we have something like a cloud. We are using all these equipment and of course has to be connected with the computer and then you transmit data through internet.

So, these are the basic overall architecture of what we call today's 4G technology. We have a computer infrastructure, then you have data communication and then you have the cloud and for the network whatever network tools you need the routers and the modems All the data, and you can access this cloud from anywhere. You can have n number of gadgets or equipment all talking to this cloud in the sense that sending data and then you store and then you do lot of analytics You need a compute infrastructure to do all the calculation, and then of course cloud being one thing which is being accessed by many people, you need to be very concerned about the security angle.

So that my company's data, my organization's data, will be secured and will not be poached by any other unauthorized person. So, three clusters are merging in the cyber-

physical. So, we are talking about the cyber and the physical, the virtual and the physical. The systems are driven by AI, which will come in, and then we are talking a lot about automation—we talk about robots or bots. Bots are nothing but soft robots or software robots.

So, we have this physical world, the human world. So, we have a driverless car, 3D printing, then advanced robotics and nanomaterials. Then in the digital technosphere, the digitalization we talk about this digital digitization, we talk about IoT's big data or deep learning, smart devices. So, billions of connected devices again that is one of the expansion of IoT. We have disruptive business model, we will talk about in my next slides. Here we talk about various business models which are disrupting the current known practices or the way companies work

So, the business model itself is changing, the way you are doing business. So, we will talk just after this class, in the next class we will talk about that. And then we have this biological world, the natural world. So, we are doing genetic analysis, we are designer plants, animals, humans, then brain implants, brain interface and then curing disease etc. You might have heard about a company called Neuralink which is founded by Elon Musk and what they are trying is have a chip in the brain,

So, you can write type etcetera etcetera. So, it is a human computer interface wireless. So, the chip is inside a bread. So, all these experiments are going on and you are using lot of AI even for that matter and robotics and computer control and very high level of computational power. to bring in these technologies to practice.

So, ultimately, we want them to be successful in the sense of helping a person do something. A person who cannot do probably is paralyzed, but his brain is functioning, so can he type, can he write, can he do some action or instruct the computer and the computer in turn can For example, they can design a 3D model or anything. Once you have access to the computer, you can try out lots of design components. So, this is how we are extending our capabilities—human capabilities—by linking with a computer. So, that is what we mean by the merging of cyber-physical systems.

So, we have these digital technologies. We are developing a lot of digital technologies, but how do we extend those technologies to our various necessities, or what we also call use cases? So, the industry—if you talk about the industry—needs a lot of such technologies not only to solve problems, but also to make improvements. Can I improve further? Can I improve my productivity?

So, we are always trying to gain things, become faster, do things faster, do things better, improve quality, and do things on a larger scale. So, can we scale up faster so that we can grow faster? Industries that robots will transform by 2025—this is about this year. So, driverless cars are definitely a reality now. So, many cities are testing out actual taxi services using autonomous cars—driverless cars.

And almost every day, you can see somewhere—some city, some town like Tokyo, Beijing, San Francisco, or Singapore—trying out all these driverless cars for commercial use. In manufacturing, 10 percent of worldwide manufacturing tasks are automated. In 10 years, that will increase to 45 percent as robots become cheaper. So, China is working heavily on this, building a larger number of robots than any other country, and they are progressing very fast. For example, in Japan, robots work as restaurant waiters. So, they will come to you. You go and sit in a restaurant, the robot comes, takes your order, goes back, and brings your food—no human is there. The same applies to supermarket stores, where many robots are finding applications in various areas.

Personal robots will take on easy or dangerous tasks in chemical industries, nuclear industries where robots are actually being used so that you do not put a human being there. Or take something like sewage cleaning. We often see in the newspapers that laborers went inside, encountered gas, and died. It is very frequent news—every month, you will see many of them dying while cleaning underground sewers. Because there is poisonous gas—methane or other gases like carbon monoxide—and they either get injured or, in many cases, die. So, can we replace human beings with robots?

Then, in healthcare, robot-assisted surgeries have now become quite common. Knee replacement surgeries are mostly done through robot-assisted procedures, mainly because of their accuracy. So, the chances of errors or mistakes are much lower. So, you have fewer failures—the failure rate has come down drastically. In finance, robot advisors—or what we can call bots, not robots—are replacing investing professionals, as forecasted.

If you can automate with through AI and combination of AI robots or bots to you know do all this prediction—share prices, for example—or tell you which shares to buy with an advisory role. The entire advisor if it comes from AI based systems probably they will be better advisors and of course, they will be much cheaper because they will replace highly-paid share market advisors. This is one of the areas where people are actively working on whether right or wrong, ethical or not ethical. Technically it is possible to

now have robot advisors giving you financial advices. Drones are now very common for all of us. So, drones have been used in agriculture to detect

what sort of actions to be taken. Plant maintenance, long pipeline maintenance, drones are being used . So now, everybody knows what drones are and what drones are capable of—the military applications of drones. Now, through WhatsApp, etc., we know what they have done and what they can do. But apart from military applications, in the civil world, of course, there are plenty of applications for drones, which have been used in agriculture, plant maintenance, mining industries, and, of course, commercially in the entertainment industry. We know drones are used for many things. So, plenty of applications are waiting to be developed for use cases for drones.

Defense, of course, we will not talk about. So, as a discussion point, you can think about or do some reading on what the metaverse is. I was giving you a brief about the metaverse. The technology is being developed by many companies, including Facebook. so, that it can be commercially used by organization. Many companies are using it, but as I told you the growth is not so fast because of constraints like cost and network bandwidth. and it is transmitted.

So, it is heavy bandwidth and computational power because you have to simulate those all these virtual situations. It needs sort of both cost bandwidth and compute power. All this is making the progress slow. But it is going on it is happening there are many cases use cases where it will become sort of essential. So, people will start using that heavily.

And this is linked with your VR technologies. So, and this as I told you in AR and VR there are long list of application areas which I showed you. So, you can do some reading on your own and find out where all they can be used and so that you in your life, in your profession, in your business you can think about situations where you can use AR. AR very easily not very difficult not very expensive and in the longer run why not try VR in various work areas. Thank you very much.