Management Information System
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Module – 09
Emerging Technologies Internet of Things Part - II
Lecture – 43
Internet of Things Part - II

Welcome back once again! So, we will continue with 'Internet of Things' in this session. In the previous one, we had discussed about, we had spoken about the internet of things architecture, we had spoken about what sensors are, what actuators are, and we had also discussed certain examples.

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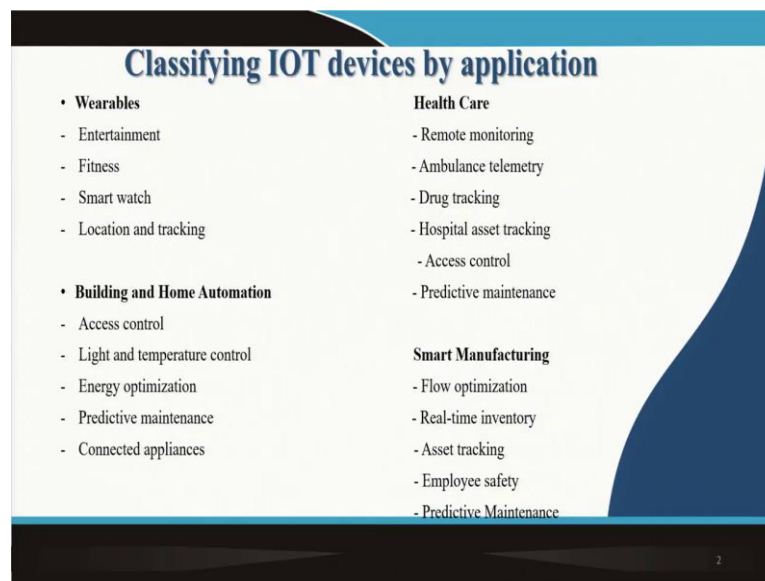
So, in this session, we will move ahead with the examples, and then we will discuss about the IOT technology, so, classifying IOT devices by application. Now, in the previous session, we have seen applications of IOT in health care, in smart cities, in residential water supply. So, IOT devices have applications in variables we have seen, so entertainment, fitness, smart watches, hand bands, for location and tracking everywhere, IOT devices have a very important role.

Similarly, in healthcare we have seen a lot of role of IOT devices. Here again we will building and home automation, so access control, light and temperature control, energy

optimization predictive maintenance. So, if there are for example, IOT sensors in built in say devices such as your refrigerator or your lighting system at home.

And, if there you know there is the sensors detect that there is some problem and maybe your refrigerator will go you know in, there will be some defect in your refrigerator in say a day or two, some problem with the refrigerator, will automatically give you a warning, so that you can go ahead and it will predict the problem in advance, so that you can go ahead and try to repair it before it actually fails.

Similarly, in smart manufacturing also IOT devices have a very important role to play such as you know in flow optimization, real time inventory tracking, asset tracking, employee safety very important, and again predictive maintenance.

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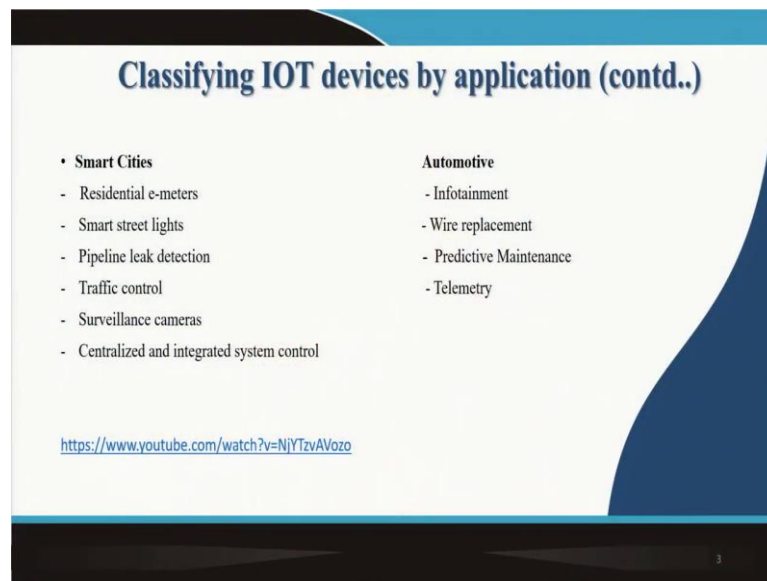
So, moving on other applications of IOT devices we have already you know I we have discussed about smart cities, so residential e-meters, smart street lights, a pipeline leak detection, surveillance cameras, centralized and integrated system control traffic control. So, we have seen some of these examples before.

Again in automotive, infotainment, wire replacement, again predictive maintenance, you know, before the automobile actually goes, you know, actually breaks down how you could actually go ahead and do a, you know, it would predict in advance that the automobile will break down.

So, you can take measures to repair it before it breaks down maybe you know while you are travelling. So, now, we will see another very interesting video which will talk about the application of IOT in different aspects in a particular smart home. So, let us go ahead and watch it.

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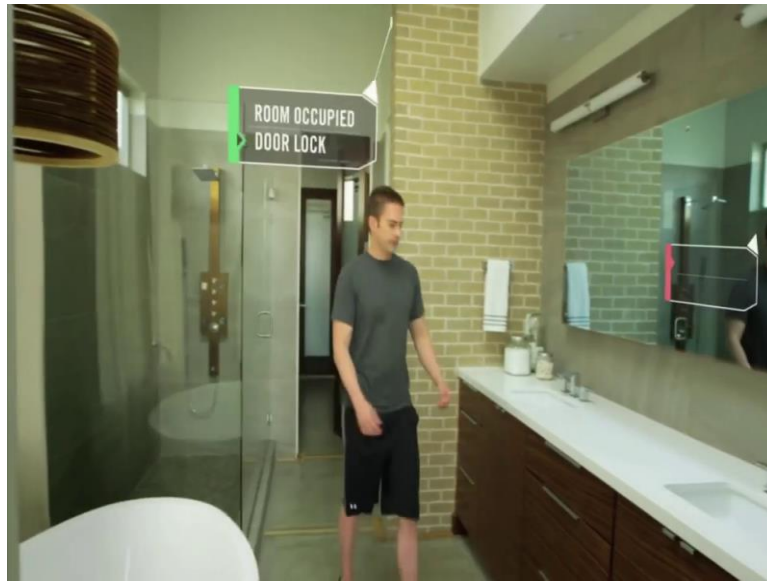
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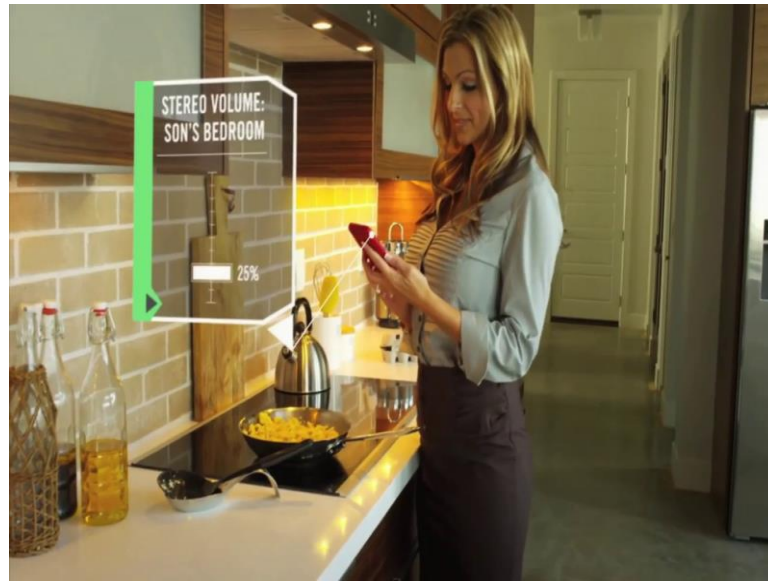(Refer Slide Time: 04:55)

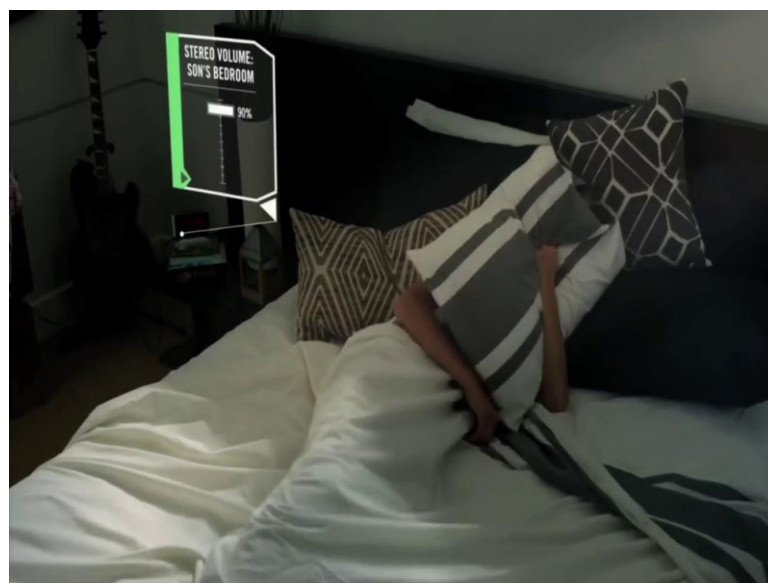(Refer Slide Time: 04:58)

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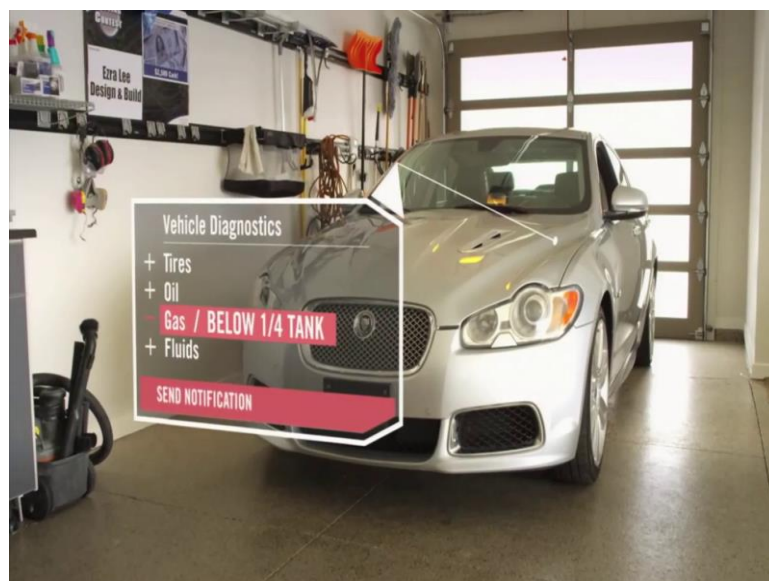
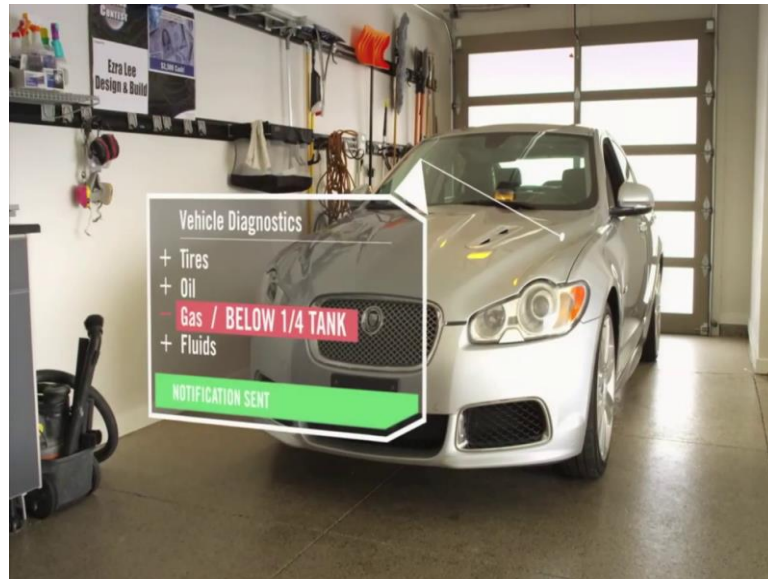(Refer Slide Time: 05:15)

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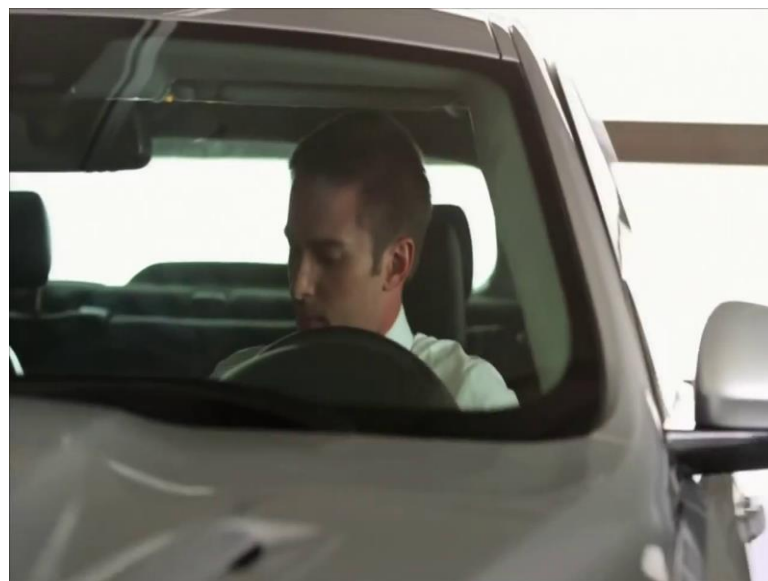(Refer Slide Time: 05:25)

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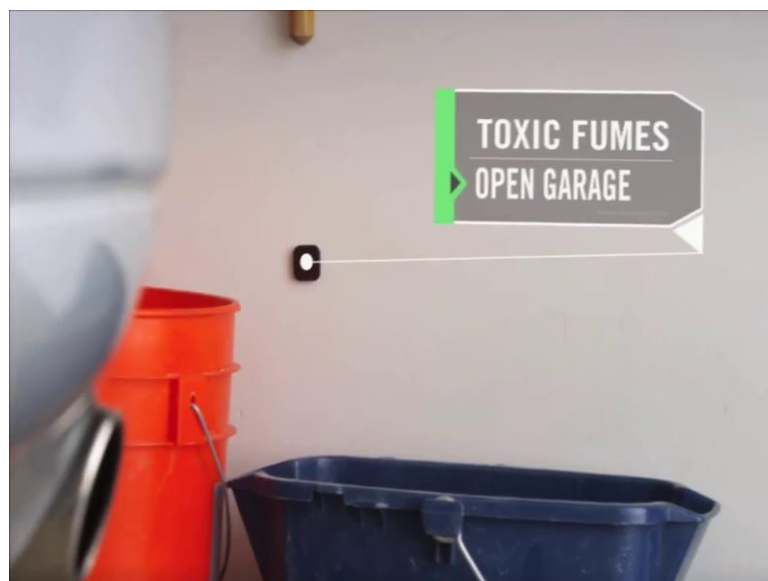
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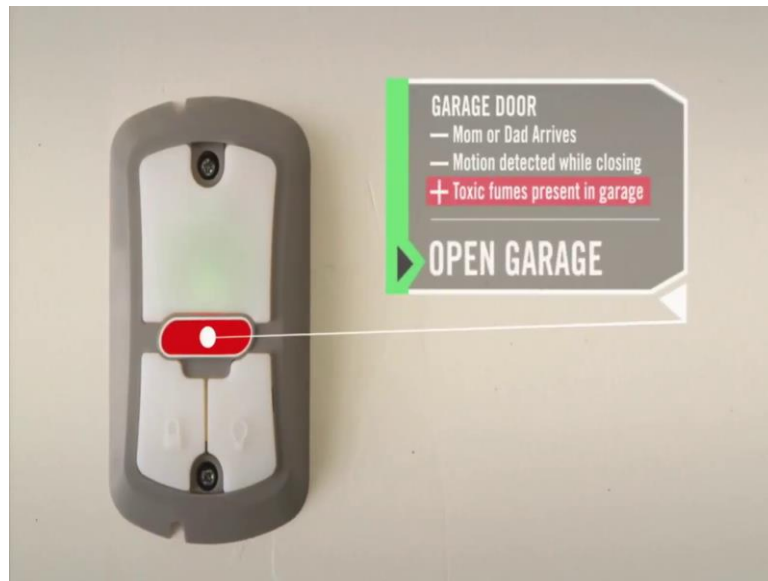

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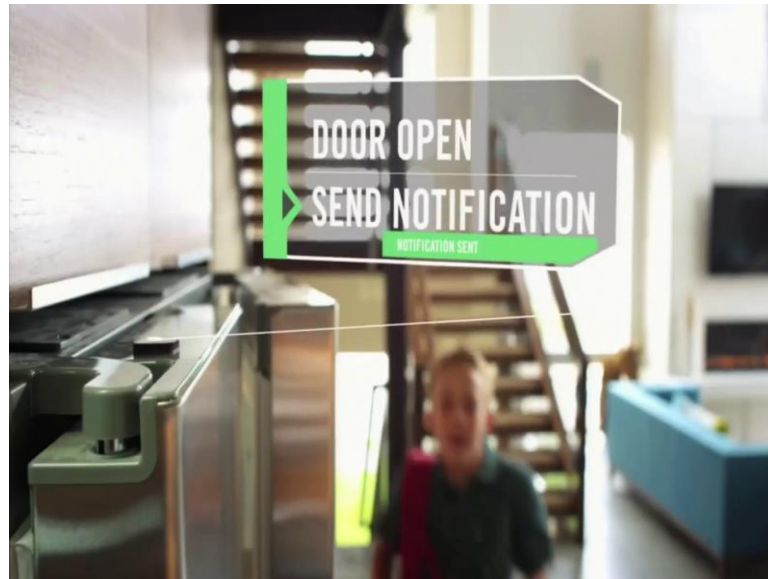(Refer Slide Time: 05:49)

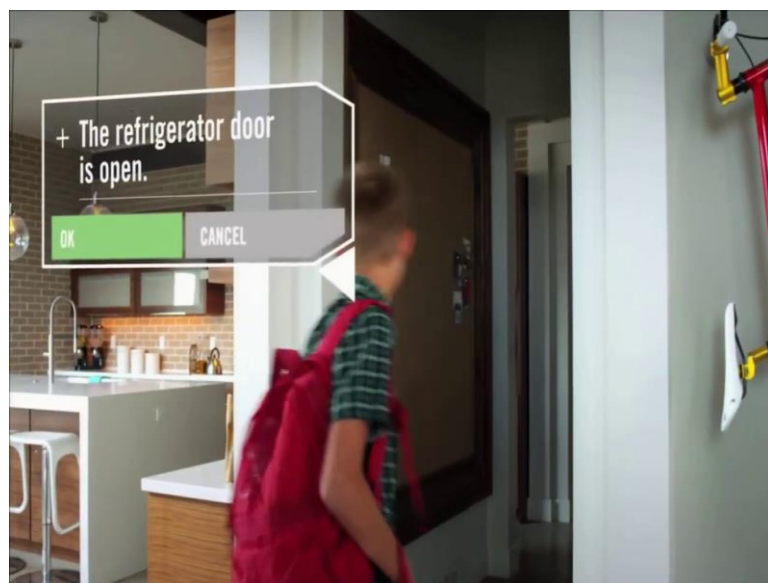(Refer Slide Time: 05:50)

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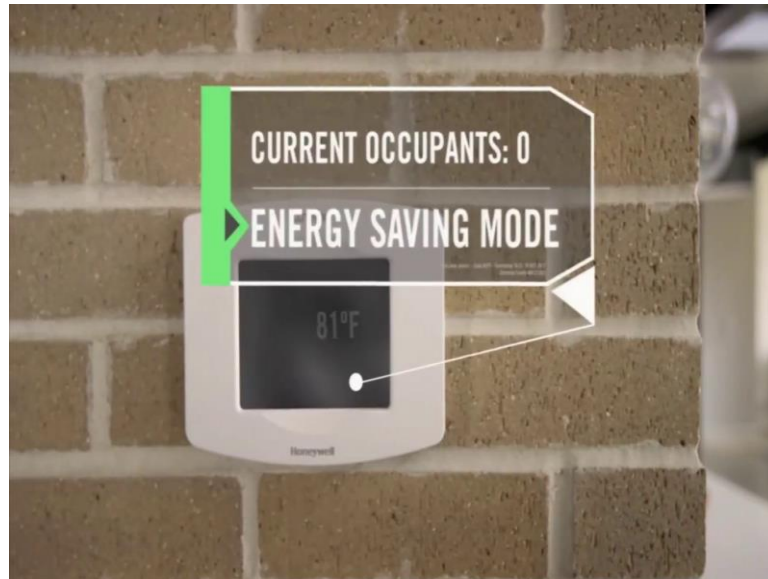

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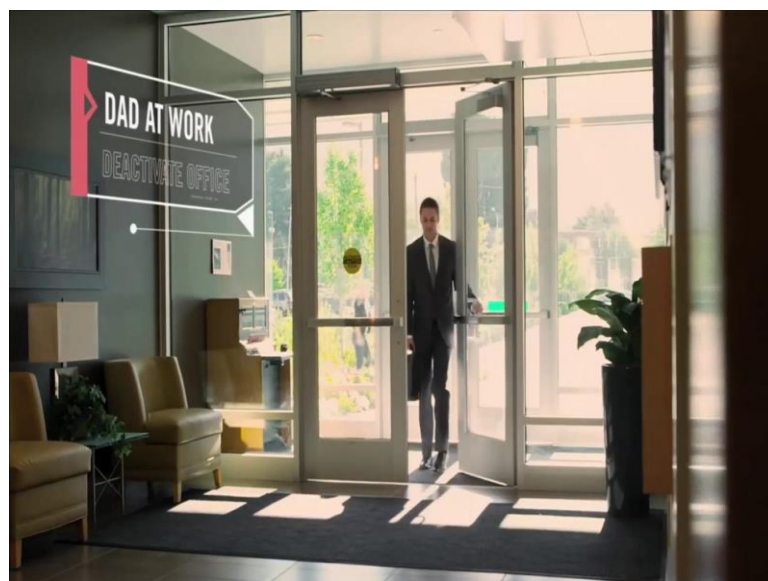(Refer Slide Time: 06:50)

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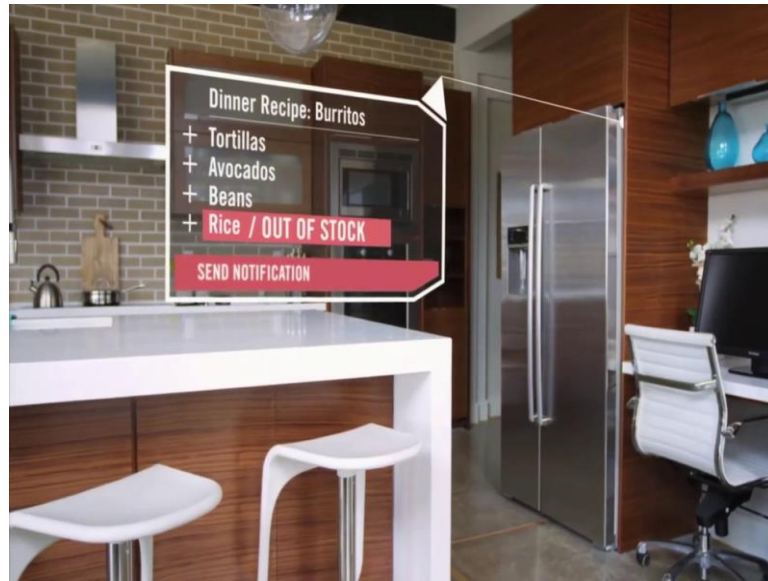
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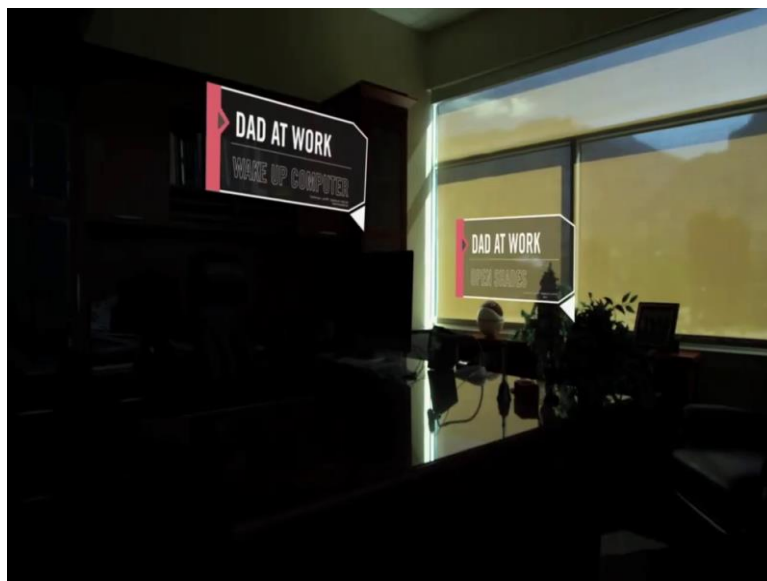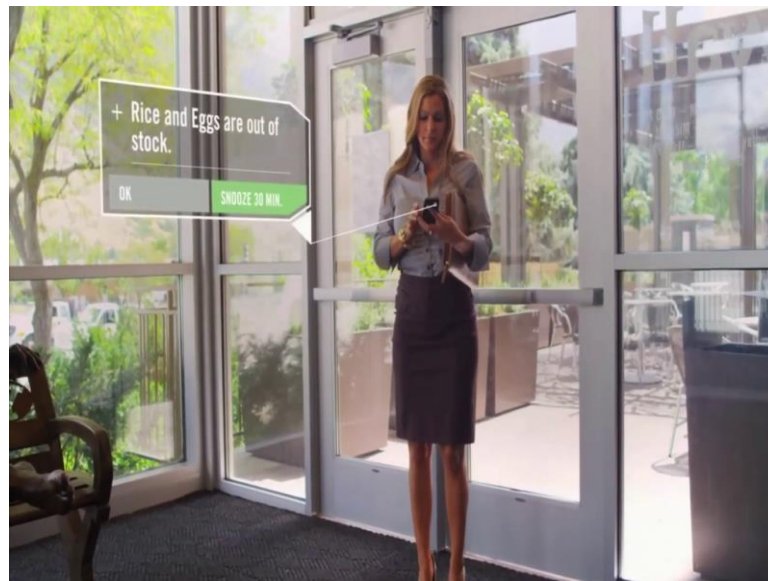

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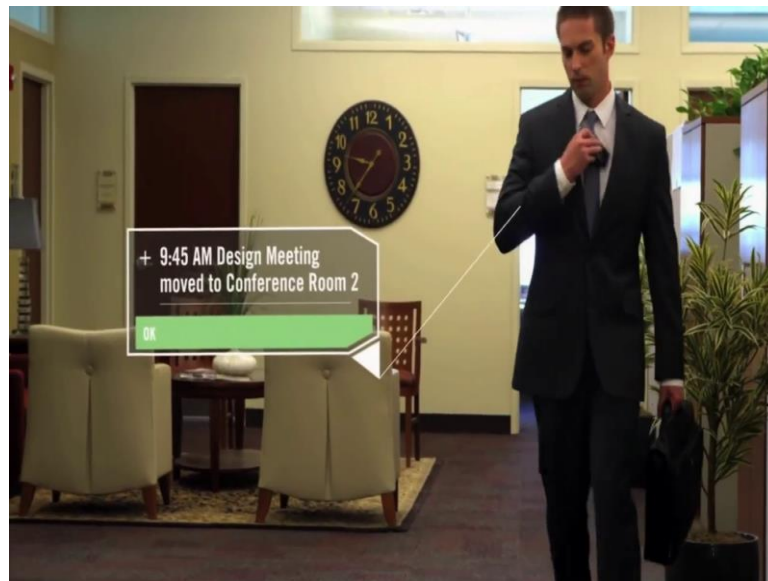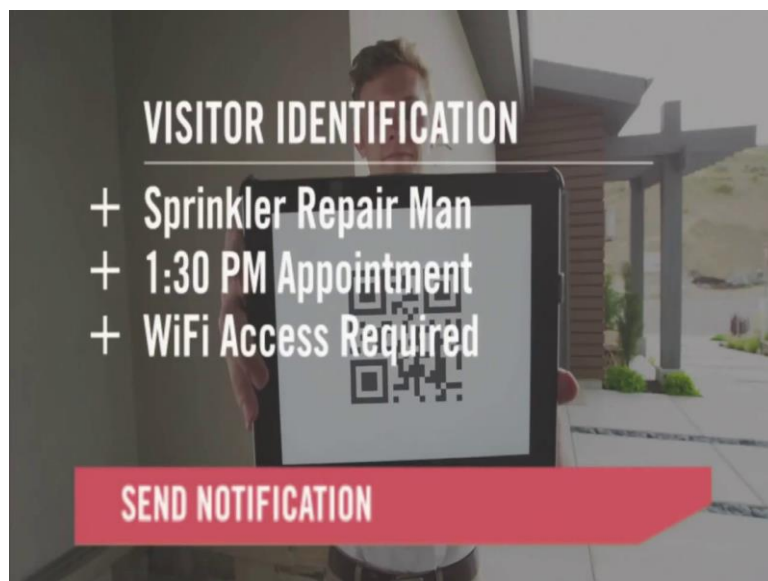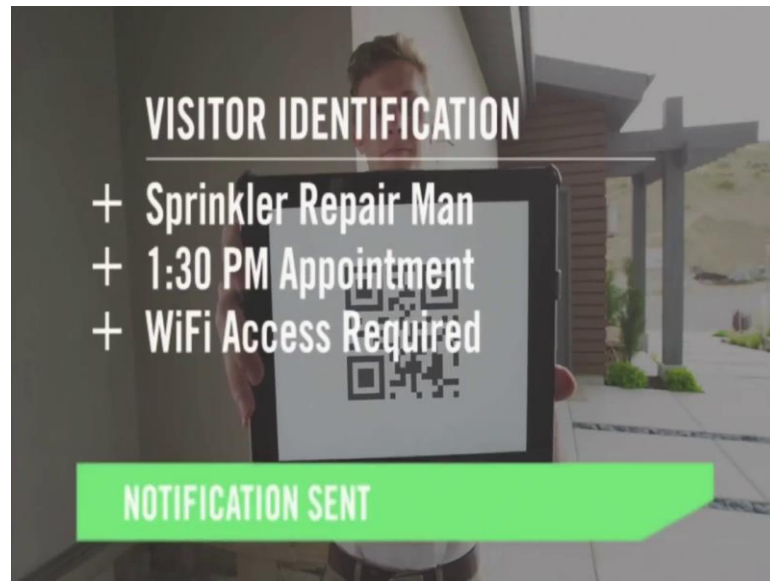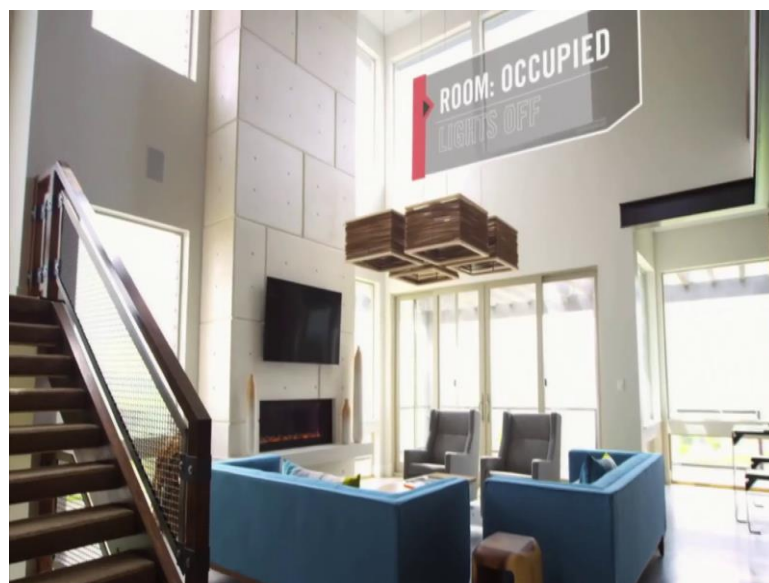

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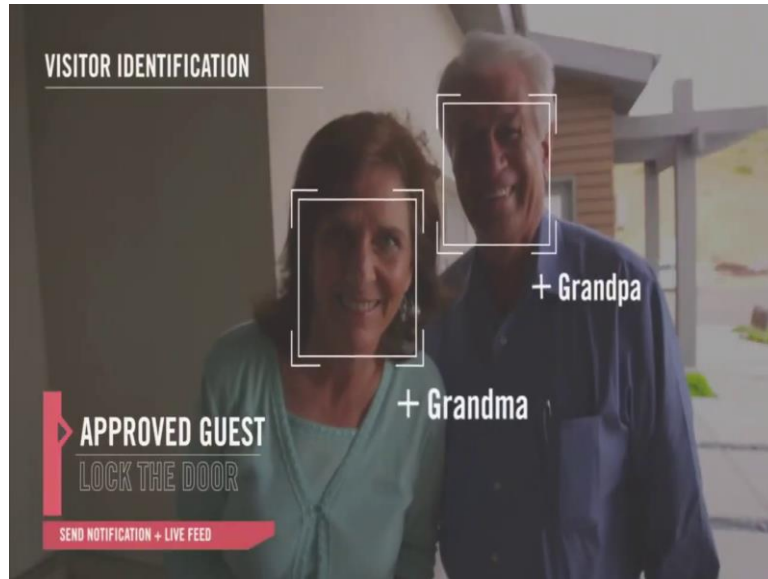
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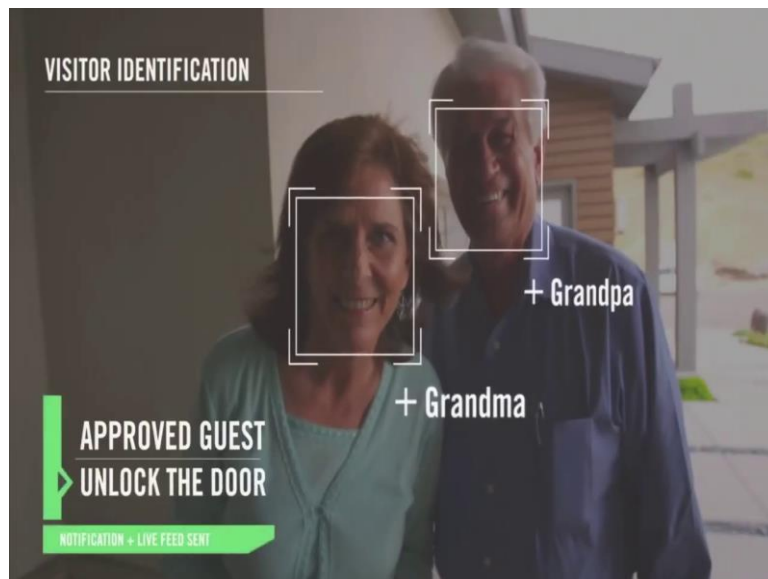
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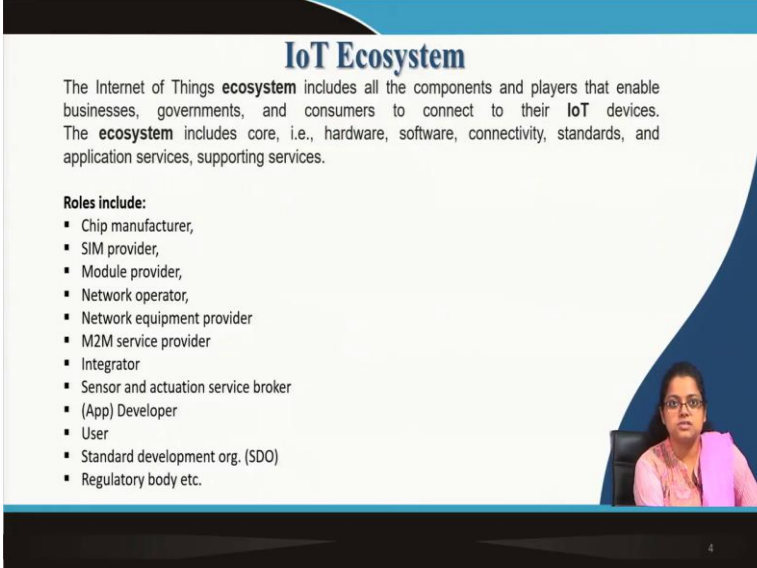
So, I hope you have watched this video. This is my personal favorite. I wish life you know could be so organized and that is how IOT would make your life organized and simple. But of course, there are issues related to privacy. If every aspect of your life is getting monitored there could be issues related to surveillance and privacy which you may not like. We will discuss that.

But yes, the arrival of IOT has enabled has you know it gives us the opportunity to make our lives much more simple and much more streamlined compared to what it was before.

So, you see how in a particular household IOT can determine everything from what is in stock in your refrigerator. It can also prompt you as to you know things that are out of stock, so that you can order in advance. If lights are off, it will give you an alert, so that you can take care of that.

So, every life is streamlined and a lot of bottlenecks are resolved. So, this applies not only to a household, this applies to any setup where IOT is deployed such as a manufacturing unit bottlenecks would could be resolved, in supply chain bottlenecks could be resolved. So, everywhere IOT has the potential to make our lives much smoother and much more streamlined.

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Now, we have spoken a lot about the applications. Let us talk a little bit about the IoT ecosystem. The IoT ecosystem includes all the components and players that enable businesses governments and consumers to connect to their IoT devices. The ecosystem includes core that is hardware, software, connectivity, standards and application services and supporting services.

So, what are the different roles in the IoT ecosystem? We have chip manufacturers, SIM providers, module providers, network operator. Of course, network operator lies at the you know core of IoT because network lies at is the backbone of IoT system.

Network equipment provider has a very important role to play. A machine to machine service provider has very important role to play, because multiple machines or devices could interact in an IoT system.

Integrator of all of these has a very important role to play. Sensor and actuation service broker of course, goes without saying that very very important because sensors and actuators are the core devices. You know when we say things we actually refer to sensors and actuators.

App developers as you saw in the case of gnarus solutions they had an app which could control the entire IoT system. Users have a very important role because they are the you know they are at the receiving end of the benefits of the IoT system. Standard development organizations because IoT is a very recent development in the world of technology and there are certain standards related to you know IoT home automation, related to privacy in IoT.

So, there are certain standard. So, these standard development organizations are also at the have a very important role to play in the IoT system because, if these standards are not there then the IoT service providers would all you know would not adhere to any standard or any benchmark. So, that could create a lot of discrepancy and a lot of you know problems. A lot of issues could come crop up related to lack of standardization.

Regulatory bodies, they are also very important. Why? Because since there are issues related to you know regulatory issues, privacy issues, there could be issues related to copyright infringement. We will talk about that in a subsequent slide. So, regulatory bodies also have a very important role, to play to resolve any disputes or issues that may arise between the parties to the IoT ecosystem

So, these are you know to summarize these are some of the important players or the important roles in the entire IoT system, without them the entire IoT system would fall apart.

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Now, moving on the key IoT technologies. So, hardware of course, is very important. Software and algorithms you know how important they are. Network as we said is the backbone of the entire IoT system. Data processing and data storage. So, all of these 5, are the 5 key technologies or enablers enabling technologies of an IoT system. Now, let us discuss these in detail.

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Hardware or things, so hardware or things you know are very important because of you know the name itself suggests internet of things. So, you cannot undermine the
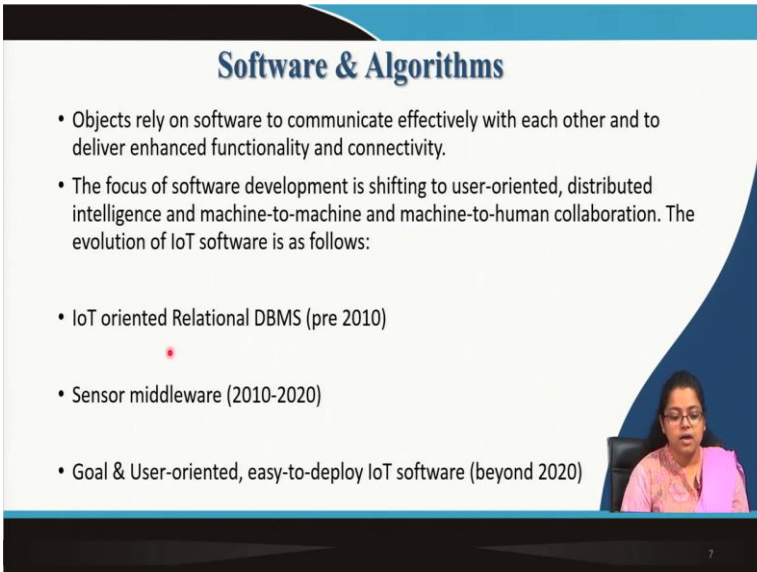
importance of hardware or things. So, before 2010 this talks about the evolution of hardware or things. So, before 2010 we had generally radio frequency identification tags and some sensors and actuators.

But some of these sensors were very large were inefficient were not able to capture data according to requirements. So, over a period of time there was an evolution 2010 to 2020, we saw more of smart sensors. And smart sensors we have discussed previously. So, we saw more of smart sensors and we saw tinier and cheaper sensors and actuators because as the gadgets you know earlier we had big computers super computers. Today we have small laptops, so we have small tablets.

So, things are becoming smaller by the day right. So, that is why sensors should also become tinier so, that they can fit into any small device. So, they are becoming tinier at the same time they are also becoming cheaper. And beyond 2020 we know that it is the world of nanotechnology. So, nanotechnology and new materials have come up. So, gradually there is a shift from internet of things to internet of nano things.

So, things have become so small that is these you know sensors and actuators have actually become so small that we can call them nano things. So, there is a shift from IoT to IoNT in terms of hardware.
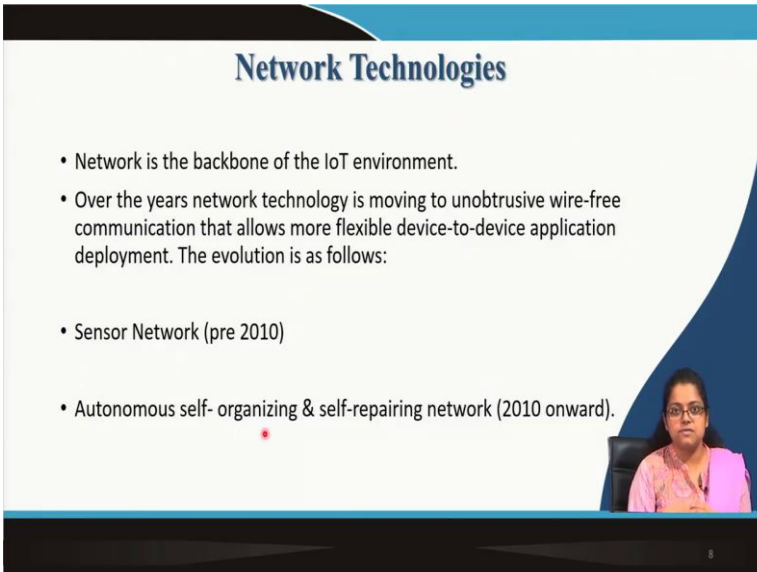
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Now, moving on to software and algorithms. Objects rely on software to communicate effectively with each other and to deliver enhanced functionality and connectivity which you have seen when we have discussed the IoT architecture.

The focus of software development is shifting to user oriented distributed intelligence and machine to machine and machine to human collaboration. So, that is the crux of IoT. There is machine to machine collaboration, there is machine to human collaboration and that is being facilitated by user oriented and goal oriented software.

So, the evolution of IT's as follows. Earlier pre 2010 we had IoT oriented relational databases. So, we have spoken about databases, relational databases in the in module 2 when we had discussed about DBMS in organizations and how data is stored. So, IoT oriented relational databases were there prior to 2010 and we had discussed that RDBMS has a lot of limitations.

So, the other you know software and algorithms that came into picture since 2010 to 2020 were sensor middleware. Middleware again has a very important role to play because they provide the connection between different objects. And finally, beyond 2020 there is a shift towards a goal oriented and user oriented easy to deploy IoT software. So, this is the evolution of software and algorithms in the IoT systems.

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The third technology pertains to network technologies. So, we have been repeatedly saying from the beginning of this session that network is the backbone of IoT because everything the entire architecture relies on the network, communication network.

So, over the years, network technology is moving to unobtrusive wire free communication that allows more flexible device to device application deployment. So, if there is a lot of complexity and if there is a lot of rigidness with relation to you know device to device application deployment, it becomes very difficult. Therefore, there is a gradual shift towards more flexible and unobtrusive device to device application deployment.

So, the evolution is as follows. Earlier it was sensor network prior to 2010, 2010 onwards you know these networks in order to become flexible there is a shift towards autonomous, self-organizing and self-repairing networks, which means that if there is you know the networks are kind of you know adhoc in nature and they can organize themselves based on the requirement.

And at the same time, if there is if they detect that there is a problem in one of the nodes of the network it the network can self-repair. It does not need too much of human intervention. So, the networks that are being deployed from 2010 onwards are gradually becoming autonomous and of course, they are becoming self-organizing and self-repairing. So, this is the evolution in the network technologies.

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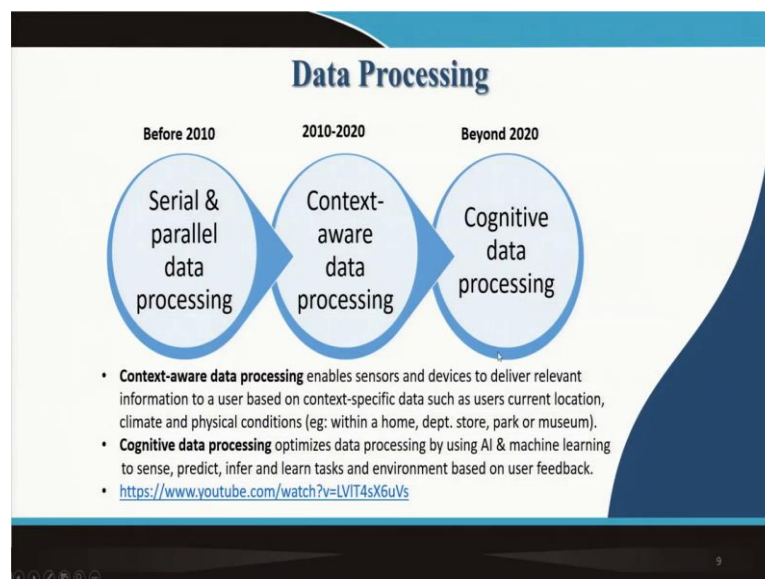
Now, moving on to data processing. Data processing has undergone a massive shift from 2010 to 2020. Why? Because prior to 2010 generally you know we did not have too much of data coming in. So, serial and parallel data processing was sufficient. A serial data processing is where data processing happens one after the other, parallel is where they can happen simultaneously, but that was not enough.

Because as you know more and more devices began being connected to the internet, so there came there arose the problem of you know a huge amount of data that has to be processed So, serial and parallel data processing were not able to cope up therefore, between 2010 to 2020 there was a shift towards context aware data processing.

Context aware data processing does not process all the data that comes it processes only selected data. So, it enables sensors and devices to deliver relevant information to a user based on context specific data. So, all a lot of data that is coming and all lot of noise that is coming through the sensors need not be processed that is redundant.

So, based on context specific data such as user location, climate, and physical conditions, the sensors and you know context aware data processing used to deliver relevant information based on users context. Such as, if the user the location of the user, you would be taken into consideration to process the data not every data that is coming. Say if the whether the customer the user is at home in a departmental store, park, or museum, so the context or the background of the user would be taken into consideration.

So, there would be some sort of you know image processing technology which would take into consideration the background of the user and that would be taken into processing consideration into processing. And, but however, it was observed that was also not enough.

So, beyond 2020, there is a huge shift towards cognitive data processing. Cognitive data processing optimizes data processing by using artificial intelligence and machine learning to sense, predict, and infer and learn tasks an environ base environment based on user feedback.

So, artificial intelligence and machine learning were used to sense predict and infer tasks, and based on user feedback again the data processing would be improved. So, cognitive data processing has a very important role of artificial intelligence and machine learning

which would make the processing much more efficient. So, we see that there is a shift from serial and parallel data processing to context aware data processing and eventually to cognitive data processing.

So, here I will share would like to share another video which talks about the you know it again talks about the role of IoT, in an in home automation, and how artificial intelligence can be used to take into consideration the context that is the home in which the user is.

And to be able to learn that is you know say the video shows if you carefully observe that earlier a music was playing, but based on the users you know BP level, blood pressure level, and other health parameters it was felt by you know the system the IoT system that the user requires a much more soothing music to relax him.

Because he is you know he is tensed. So, this is the system IoT system then switches to a most soothing music. So, that is where cognitive data processing has a very important role to play. So, please observe this video.

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Than your doctor, your next refrigerator may know more about your diet than your doctor.

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How many objects do you have that are connected to the internet? About a decade ago you probably would have said one or maybe two if you were an early adopter of smartphone technology.

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But today, I have got a well computer, I have got a personal computer, I have got a tablet, I have got a smartphone, I have got a video game console, I have got a media player, I have got a smart TV, I even have a smart refrigerator.

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Now, extend this trend outward and what do we get. Well, it is estimated by 2020 there will be 50 billion objects connected to the internet.

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Now, that is billion with a "B".

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It is also estimated by the US census bureau that there will be 7.6 billion people alive at that time. So, that means, that for every person there will be 6.6 objects connected to the internet.

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We are talking about a world blanketed with billions of sensors. These sensors are taking information from real physical objects that are in the world and uploading it to the internet.

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It is a world where your environment transforms as you walk through it because technology that you may not even be aware of is monitoring your every move.

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It is a world that is constantly changing all around us due to these sensors and the internet and we call it the internet of things.

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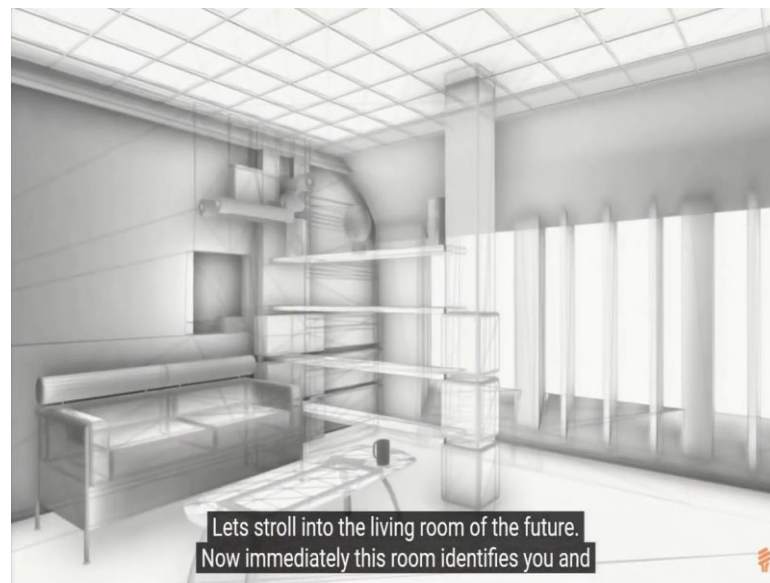
Let us stroll into the living room of the future.
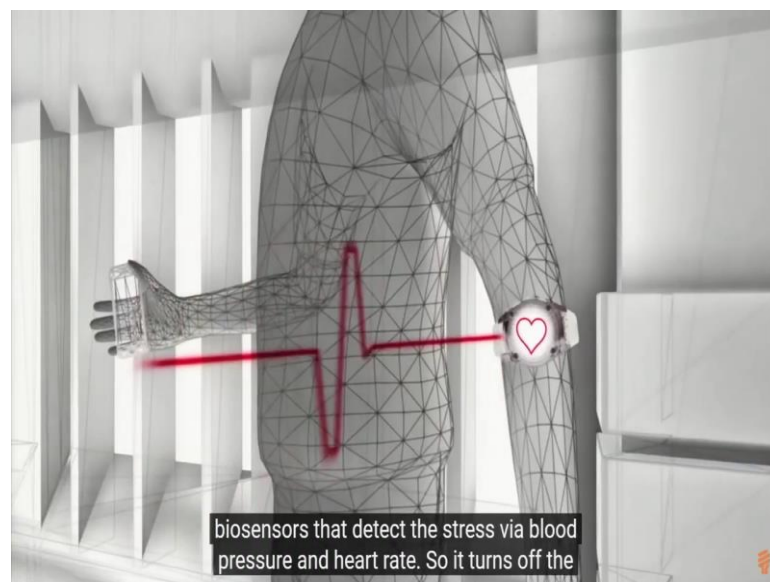
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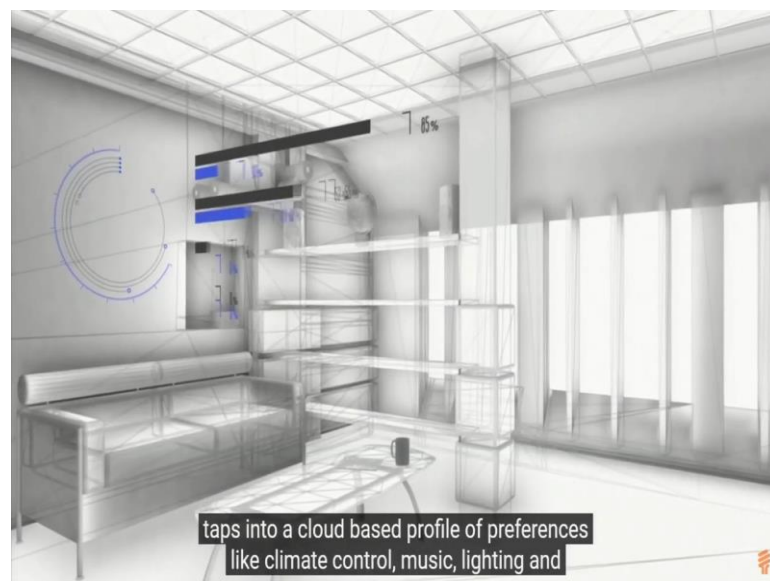
Now, immediately this room identifies you and taps into a cloud based profile of preferences like climate control, music, lighting and decor.
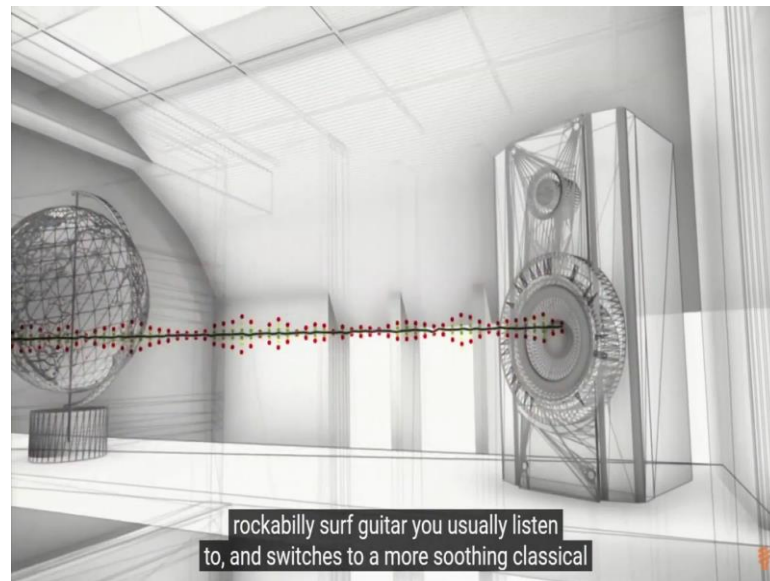
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Had a long day at work? The room knows based on the calendar app on your phone and biosensors that detect the stress via blood pressure and heart rate.
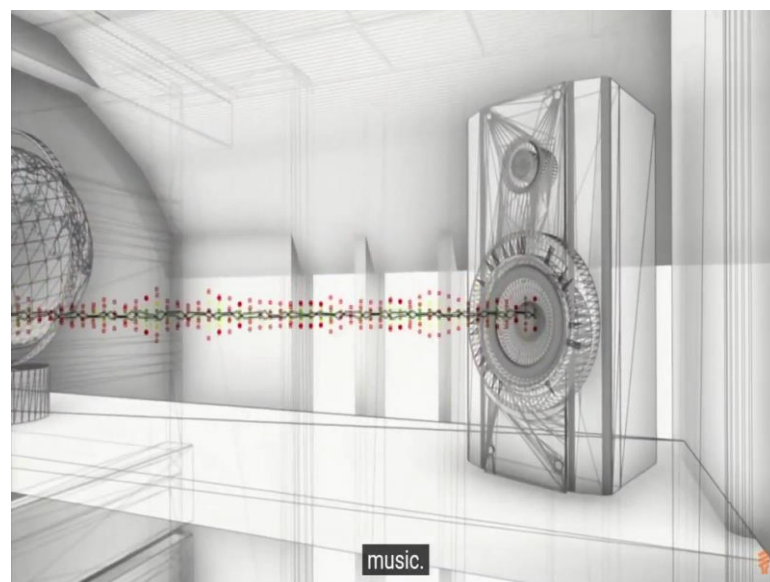
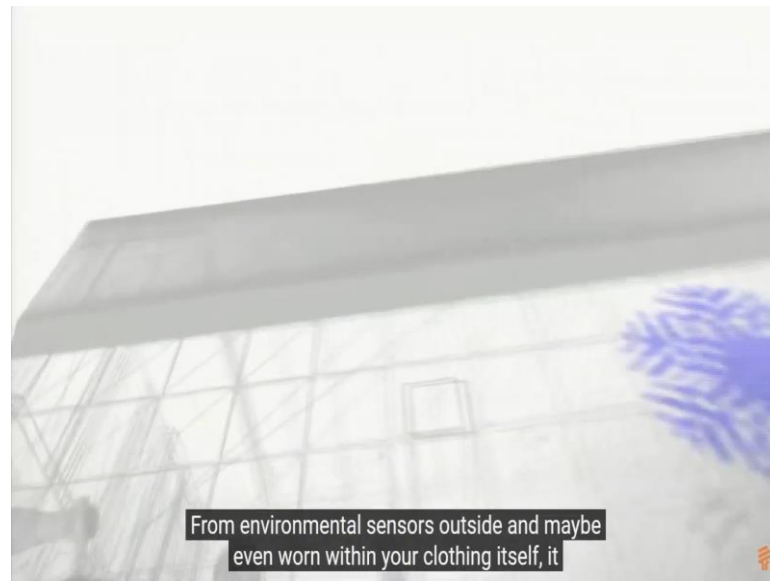(Refer Slide Time: 26:09)

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So, it turns off the rockabilly surf guitar you usually listen to and switches to a more soothing classical music.

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From environmental sensors outside and maybe even worn within your clothing itself, it knows it was snowing earlier.

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So, the climate control begins to crank up the heat in anticipation as you walk through the door.

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Now, on the software side we are talking about algorithms that are so sophisticated, they may be able to predict what you want before you know you even wanted it.

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So, when you walk to the refrigerator it tells you not only what is in there, it tells you what you can make with the stuff you already have.
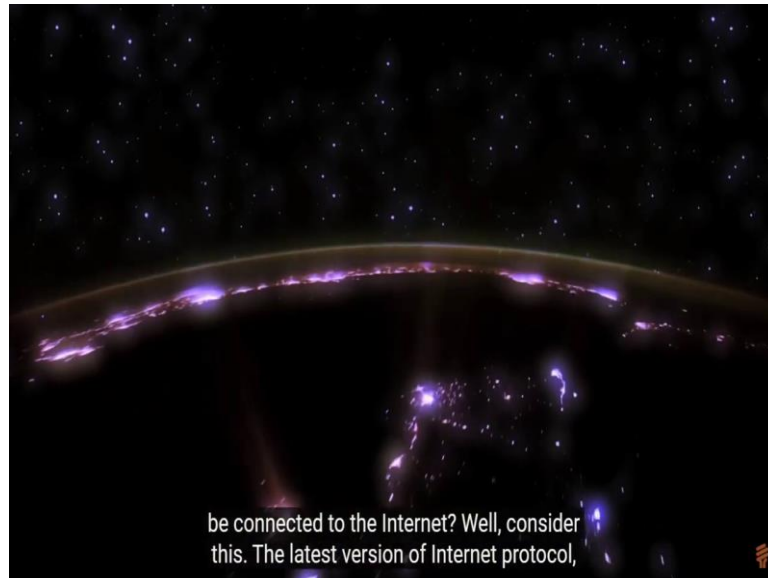
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And it is already telling you what is inside and what is the perfect meal based upon your mood, your activity level, and maybe even well your weight loss plan for some of us.

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As for how many objects could be connected to the internet? Well consider this.

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The latest version of internet protocol, IPV6, creates more potential addresses than there are atoms on the surface of the earth.
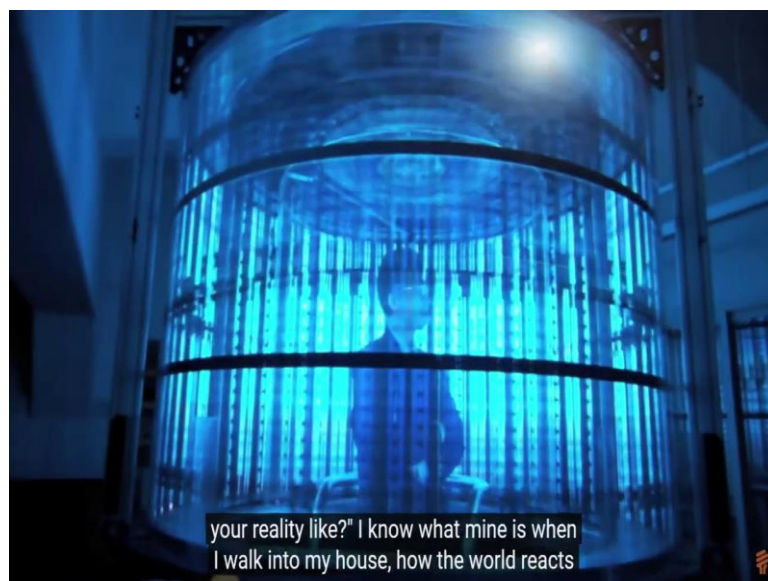
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So, we are going to live in a world completely filled with sensors, with data reacting to us, changing every moment dependent upon our needs. I am no longer going to be asking you; hey, what is your favorite color? What is your favorite music? I am going to ask you, what is your reality like?

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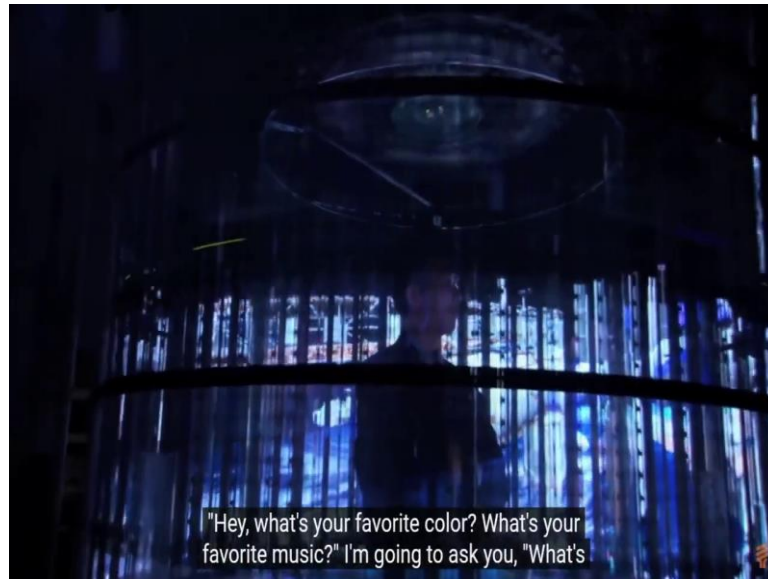
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I know what mine is when I walk into my house how the world reacts to me, but how does it react to you this is more than philosophy, it is more than technology, it is altering reality as we know it. And it is all regulated by the internet of things.

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So, coming back. You observed that you know by this year that is 2020 and beyond, so on an average every individual will be connected to 6 point will have 6.6 objects that are connected to the internet. So, that was predicted earlier.

Now, so if so many devices are connected to the internet there that there are a lot of advantages, at the same time there could be a lot of issues related to data privacy, data collection, data storage and data processing and that is why we saw this shift from in data processing towards cognitive data processing.
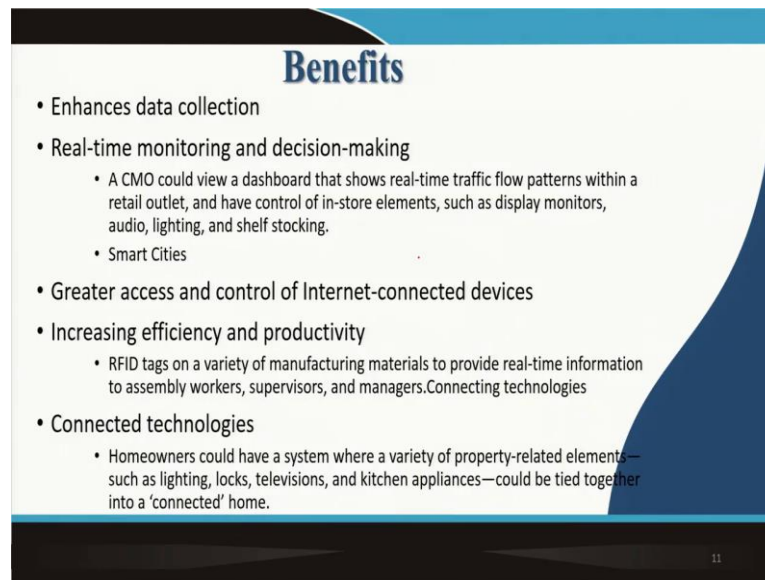
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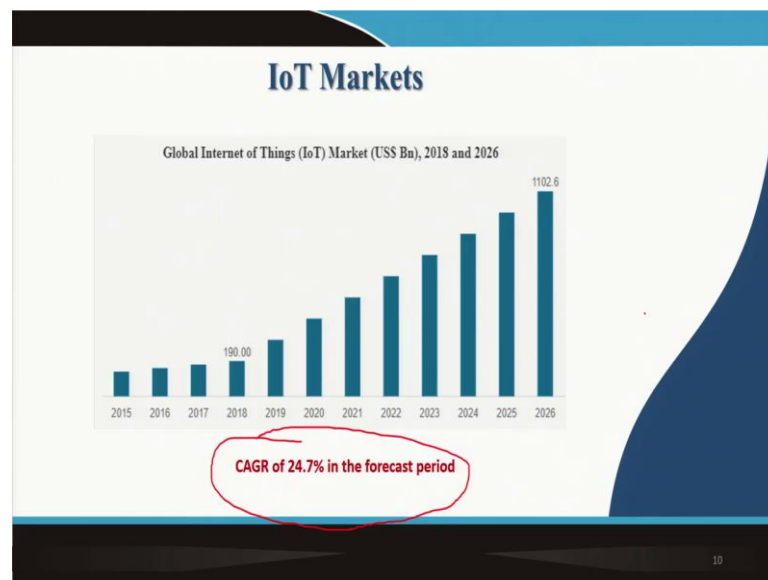
So, moving on you know these we have discussed about the technologies. Now, coming to IoT markets, you would observe that the global internet of this particular graph shows that the global internet of things market between two; so, 2018 it was 190 US billion dollars whereas, in 2026 it is predicted to go up to 1102.6 US billion dollars.

So, CAGR of 24.7 percent in the forecast period. You observe here a CAGR of 24.7 which is huge. So, there is a huge potential for IoT in the global markets in the upcoming years.
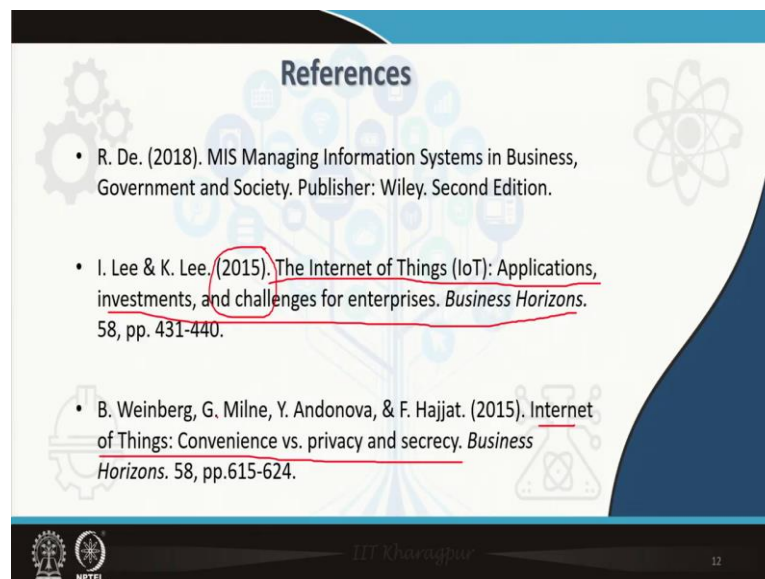
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So, IoT has a lot of benefits. I think, you know, we have discussed a lot of applications today; we have discussed the technologies today. The benefits and the challenges of IoT we will take up in the next session on IoT, where we will focus entirely on the benefits of challenges of this particular new evolution or this new technology.

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Now, I would want to highlight that this in this particular lecture, I have referred to two very important papers or journal articles, journal papers. One is 'The Internet of Things:

Applications, investments, and challenges' that you see here for enterprises which was published in Business Horizons journal in 2015.

And the other is 'Internet of Things: Convenience vs. privacy and secrecy', which was also published in the same journal in 2015, in the same year. So, these two articles are very insightful. Please if possible, download them and go through them in detail to understand about internet of things better.

With that I would like to end this session. Thank you! And see you in the next session, where we will discuss about the benefits and the challenges related to internet of things!

Thank you once again!