The Future of Manufacturing Business: Role of Additive Manufacturing
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Lecture – 15
Manufacturing and IIoT - I

Today, we are going to be having a session on industrial IoT. This will have two parts and the first part will cover the sensors. The second part will cover the connectivity network and the industry application. My name is Murali. I am from NPEDIA Technology. Let us go into the session.

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IoT stands for Internet of Things. So, let us go into figuring out what does it mean and how things are coming together for us. It has three components and the components are sensors, connectivity, and people and processes. Let us take a moment to understand what constitute each of the component.

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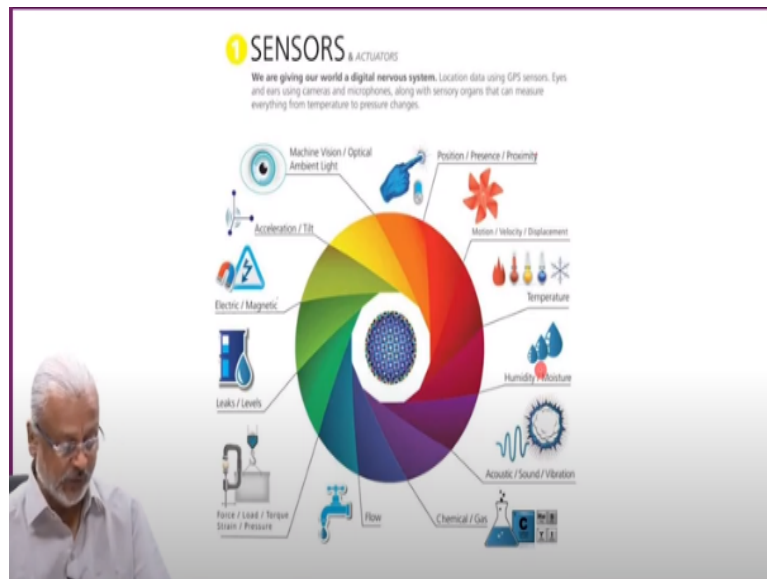
Sensors or in other words you can call them actuators as well. Previously these were mechanical systems. The sensors were measured and the mechanical actuators may trigger a particular action. But nowadays, we have sufficient electronic technology and sensor technology available for us that gets integrated and it gives us the necessary bounds in terms of offering lot more acceleration in the IoT system.

In other words, we could almost call sensors as the digital nervous system in one way. Let us look at each of these and understand them. The camera or image related activity is machine vision and optical or ambient lights and acceleration or tilt in a particular framework, you will be able to measure. What is interesting to notice, each of the sensors you will notice that many of them are available in even in a smartphone.

Whether it is electromagnetic level or you look at the motion velocity or displacement, or position presence or proximity, or temperature. There are additional sensors. These days they are available through Arduino sensor boards, you will be able to measure it and integrate it into your solution.

Those are leaks or levels for liquids, force load, torque and strain or pressure, the flow of any of the liquid that you may have, chemical or gas leakage, acoustic or sound vibration, humidity, and moisture. In each of this you are able to convert the measurement in one way into some kind of a metrics and these metrics can be

converted to digital signals or digital observations. You are able to build your analysis and your recommendations and your solution around the sensors as well.

So, this becomes an important one in terms of building the IIoT block, if you will. Most of the sensors that you see is available in the market or in some kind of a solution in the lab. You will be able to quickly put together any solution that you may want to develop for the industry, if you will. Let us look into the next important component namely the connectivity.

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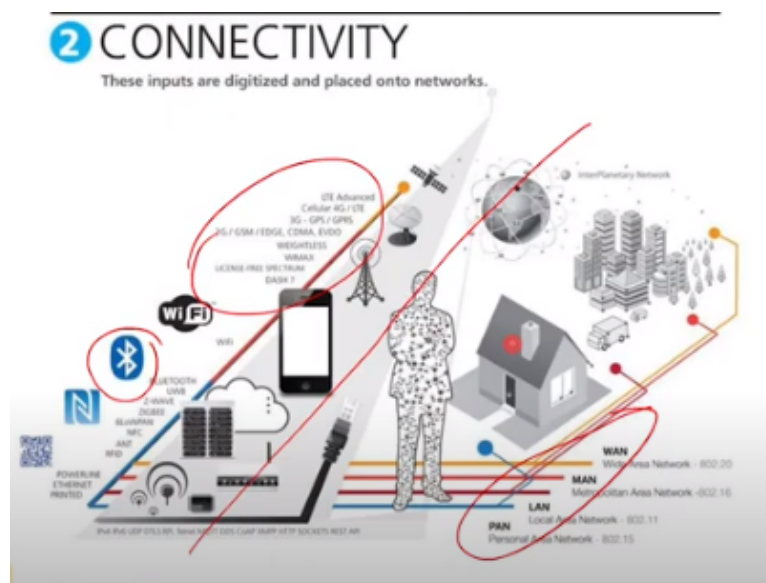
Connectivity is again an important one. The earlier one that we saw sensors is collecting the data, this is at the edge and when you come to the connectivity part of it, this is the one that will allow us to transport the data into the central system or into the control system if we will. Now the connectivity can happen in two ways. One is through wire and another is through wireless.

You can see the demarcation coming up here. The wireless can start from satellite communication all the way up to even a 2D or a single the barcode. From that you will be able to convert your measurement or metrics and then you will be able to do the take the necessary action around that. RFID, NFC, Zigbee are some of the new protocols coming around in the connectivity arena.

Bluetooth has been there for quite a while. WiFi is for is between the system and mobile is using quite a few of these technologies to communicate about some of the

earlier sensors that we talked about, you know some something like an acceleration or a tilt, or position or presence or proximity are all communicated through this. Now if you come to the wired part that is interesting.

You know you could have the personal area network, local area, metropolitan and WAN. These are the physical network, if you will and then you will be able to use the city level network connectivity, home level network connectivity to transport the data from one spot into the other one. So, this becomes the second key building blocks far as in terms of integrating the Internet of Things solution into an accelerated IIoT capability, if you will.

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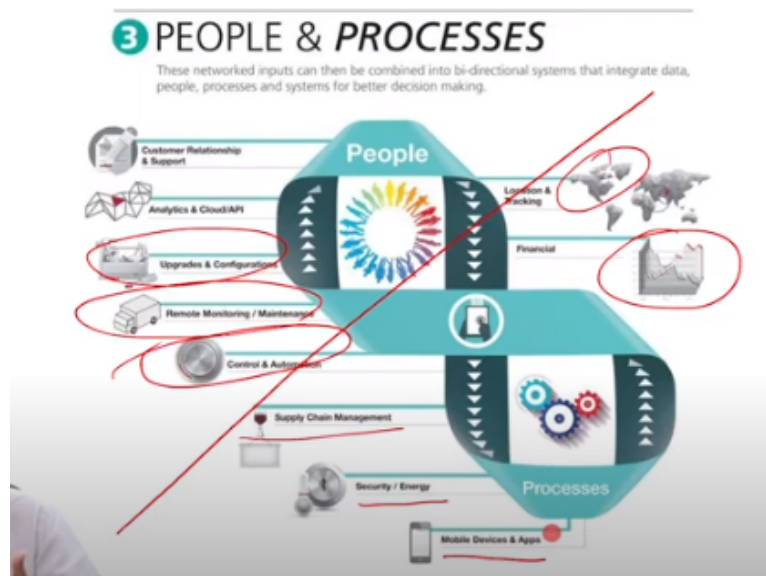
Let us look at the third part. The third part is the people and processes. Once you have the data, and you have the transport mechanism, then you have the processing activity that will help us to have a specific solution put together and respond accordingly to the needs of the system or the people if you will. This has two part to it, one is the people another is the process. You will see the top one is talking about the people part of it.

In that you will see the customer relationship support, analytics and cloud API and any of the upgrade or configuration that you may be having and remote monitoring and maintenance. Each of them if you look at it is very closely related to people related activity and that helps that forms the major building blocks for the Internet of Things. The second part is the location and tracking.

And any of the financial numbers to figure out if it makes sense for you to implement that particular solution if you will. If you look at the processing part here is where it gets interesting. The supply chain management flow, the security and energy and the mobile devices apps are the one are heavily falling into the process.

This is making sure that the edge level data is collected and connected through the network coming into our central analysis or a partial distributed analysis framework. You are doing all the necessary processing into that and the standardization and the best practices around that will determine as to how well your solution is going to be.

So, at some level, these network inputs can then be combined into bidirectional system, that integrated data, people, process and systems for a better decision making. The whole IoT is able to collect the edge data, bring it into this part that we would like to do the processing and the standard and the best practices will allow us to move further and do the executive decision level support in terms of the analytics, in terms of the best processes, in terms of the control and automation.

All these things happen in a very effective manner. So, now that we have understood the sensors, the connectivity part and the people process part let us go into the next important part, namely the IoT platforms.

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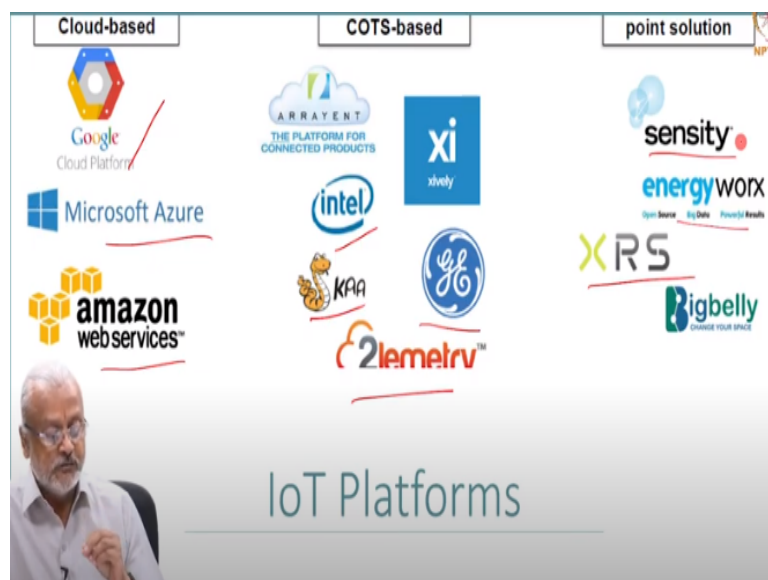
These are the one that helps us to provide the necessary tools in terms of designing our solution in a rapid fashion. Now these are the platform that are targeting more towards low code or no code-based solutions. Sometimes you may have to develop the interface between the edge devices through the connectivity into the cloud-based solution. Some are generic cloud-based solution.

Some are commercial off the shelf software solution and some are very specific to a particular vertical industry. Example of a Google or a Microsoft Azure or Amazon are generic solution, where you will be able to use their IoT platform to collect the data, build the dashboard, build the actuation, build your solutions, making sure that if you are building an energy optimum solution, you will be able to develop and things like that.

COTS-based solution if you look at it, you know whether it is GE or telemetry or KAA or Intel, they are standard solution that are actually packaged quite well. You may not have to or you need not have to code much and you will be able to develop a solution in a very rapid fashion.

On the other hand, if you look at the point solution, whether it is energy works, or XRS or sensity, these are very specific vertical solution that are integrated into that and the best practices with respect to the energy consumption with respect to the ways in which you need to measure it, the ways in which you need to alert the operator everything comes together in a very effective manner in the point solution.

These are the emerging IoT platform, that you will be able to adapt it for your industry. Now when you combine the IoT and the industry practices, which we are going to come in a short while will help you to design your overall solution in terms of how to accelerate and speed up productivity and efficiency for a overall industrial internet of things based solutions. So, let us go on to the next one.
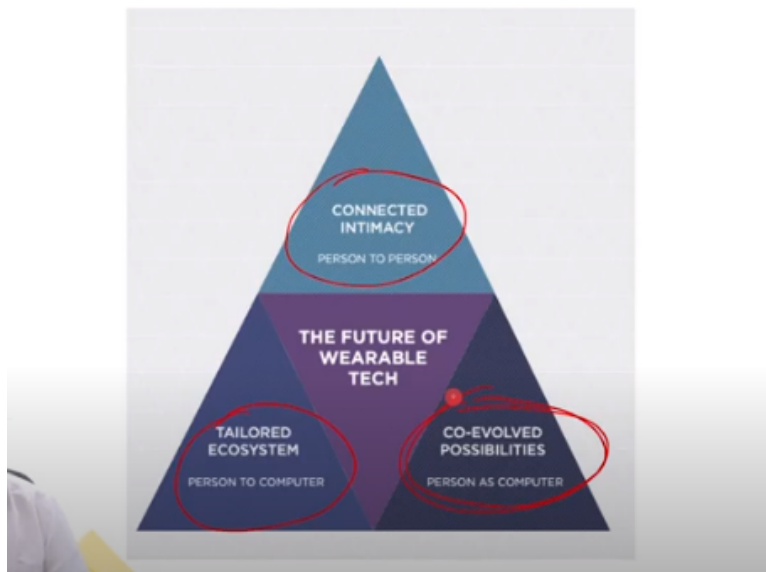
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Now, when we talk about Internet of Things, based on the for the industrial environment, we need to understand one of the key trends that has emerged in the last I would say 5 to 10 years known as the wearables. So, we need to understand the wearable in a very effective manner.

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So, there is this particular vision that talks about how wearable is influencing the technology. Now the wearable technology is broadly classified into three areas. First is the tailored ecosystem that is, whether you wear a watch or whether you wear a Google glass kind of things or wear a helmet for operating in the industrial environment, or probably have a tablet for yourself.

Either of the case, it is a person to computer kind of a interaction, where the environment metrics are measured, and then it is communicated to a system and then analysis and actions are taken based on the measurement that we had taken. The next one is the connected intimacy that is person to person. I could be wearing a watch and it could be communicating to your friend or relative.

There are cases where there is a blanket for the child and it can be adjusted to give the similar feeling of a hug from a mother. Today it is an existing product. So, the future of wearable tech is heading towards that where you are able to give instruction to the IoT device, that is from a person to person information that is passed on and actions are taken on that. The third one is the person as a computer. That is you are wearing some kind of an IoT based suite and it is able to track your action.

This is coming in future of work and all your activities are recorded to assist you in being more productive and more efficient in terms of what are the next action to do and things like that. So, it is almost like a cobot you can imagine. A dress or a wearable that you are wearing, works with you to augment your capability. It could also be something like a exoskeleton that improves your capability to do to lift more weight, if you will, in a particular job operation.

You could install another robot to work with you, but the challenge there is investment in terms of additional robot instead you know enhancing your own capability by measuring your basic strength. For example, relatively thin person needs additional support whereas, relatively well-built person may not need that much support.

The wearable that you are wearing is aware of these variations between person and will be able to help you appropriately. That is the one where we are talking about person as a computer. So, these are the future of wearable technology that are getting classified in one way.

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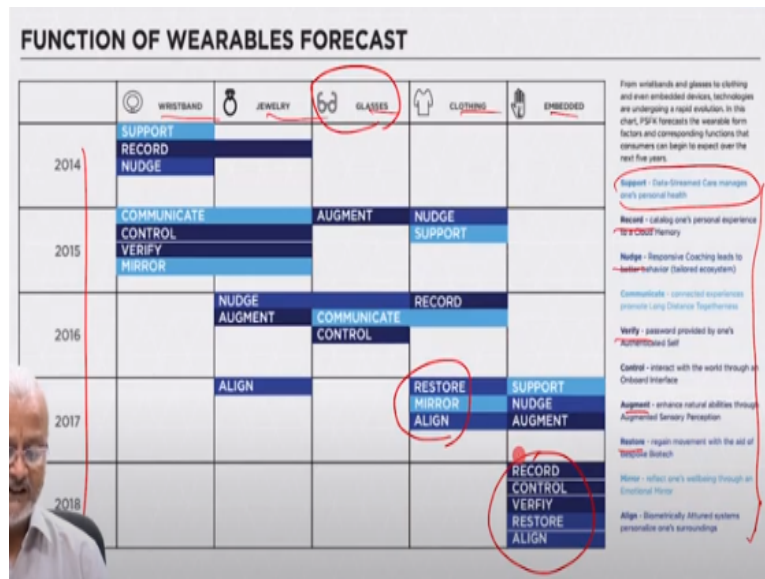
Now let us look at the possible ways in which wearables are getting. You know this the chart is very useful one. It is also tracking in terms of you know what has happened in the past. Originally it started with wristband, you could have a jewelry, glasses, clothing, and probably in future or probably something has happened already. These kinds of devices are kind of put into your body itself.

Tthese kinds of capabilities are one is kind of interesting, depending on the solution that you want to build, you could choose a particular type of devices that you want to develop and integrate it with your solution.

So, notice the legend here you know the support means, you know data is streamed, care managers on one's personal health, record is one activity, nudge is more like a sportsman behavioral correction, or even a student behavior correction. Communicate is the one it is able to transfer data from one system to another system and verification is more from the authentication side.

Control is interacting between the device and the centralized system and augment is the way to enhance your capability, the one we talked about the exoskeleton. Restore is you know something like, regain some of the physically handicapped movement that you already have. Mirror is to reflect on one's wellness.

Align is to, biometrically attune to system and personalize one's surroundings. So, these are the activities that you will be able to develop and interestingly you have

these wristbands, jewelry, glasses, clothing and embedded. So, if you notice wristband originally were doing only support, record and nudge. Now it is able to do communicate, control, verify and mirror.

These are working with healthcare system, even in some industrial environment, it is already there. So, it becomes useful one. Some trials had happened in the in form of a ring that you could wear, it kind of an alert and augment some of the capabilities were there. Glasses is interesting that the next generation of glasses are coming up.

Augment means you could look at a workshop and it can give you spontaneous information about which machine needs to be serviced, which need to which can go on the regular production activity and which needs hauling and maintenance. Some kind of a preventive action can be taken. Predictive failures can be achieved.

Your overall inspection on the shop floor machineries and productivities and capabilities is much more enhanced in a kind of a glass that has helped you to augment. This is happening already in many of the factory environment, if you will and next one is clothing. It could it could be a apparel that you are wearing or it could be an additional one that you are wearing on top of it.

Some kind of an exoskeleton also kind of forms into this. It started with nudge and support. Now it can record. You know basically for sports activity; it can be there. Interestingly post COVID-19 you can imagine that, you know it be kind of a uniform, to track your daily activities and help you to achieve your task on a daily basis, track your health, track your activities.

All these can be effectively done. The next the restore, mirror and align is also interesting. So let us spend some time on this. Sometimes what happens is, you may have an injury and you may want some additional support in this and we are used to if it is leg, we are used to the crutches that we used. But you can think of a sophisticated wearable that you are wearing.

It helps you to kind of walk around and support you as well and mirror could be you know how well you are feeling, it becomes important. Again, you know I hope I am

not beating the horse to death here. Post COVID you need to feel if you are feeling like coughing or you are catching a cold, how well you are feeling, some something like an Aarogya Setu measurement that are getting measured by querying the individual.

This can happen slightly differently. This can happen in terms of automatically collecting all the information as well and the final one is the align you know. So, when you build such assets, you could build it for small, medium, large.

But when it is appropriately treated, and the next person wears it, what may be more interesting is that depending on the next person's ability, or preferences or biological signals, the system should adjust itself. So, I think we are seeing the next generation of wearables that are sensitive to this as well. The final one is the embedded one.

Embedded one is an electronic circuit that is embedded into our skin. Lot of things have come to the extent of Nano robots as well. Sometimes, some insurance companies have looked into that very closely and many of the industry people are also looking at in terms of safety, and in terms of augmenting the individual and in terms of recording all the activities so that they can teach cobots to deal in a way that an expert would deal with their situation.

All these activities can be done with a embedded system. The system that is embedded will keep communicating to the nearby system. This is classified in the wearable category. You will be able to record, you will be able to control, you will be able to verify, restore, and align.

There is a TED lecture, where it uses these embedded circuits and people will be able to use their hand gesture to orchestrate the robot movement from the outside. So, even in the cobot environment in the, for the industry, if you look at it. These kind of embedded system for the industrial worker will help them to increase their ability and agility to work with multiple system in a very effective manner.

This as a table, I would say can also be a reference for you. So, you can always look at individually. You may be able to extend it for any of the future wearable that one

may encounter. But this in essence, will help you to internalize and understand about how a wearable can be configured, leveraged in the factory environment, to integrate with the IoT solutions, if you will.

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So in the wearable that you need to look at it. It kind of layered into three sections. One is something near our body. So, that is where you will see something like a brain control headset, wearable alarm system, GPS tracker, AR headset, sleep monitors, wearable cameras, activity trackers, smart watches are they are all closer to the body.

Very interestingly, you are able to achieve quite a few of the controls and record that you want to achieve. Remember, it is very similar to the wristband or jewelry or the glasses that you are wearing and the next one is interesting. It is on the body, you know something like a EEG or EMG device, hearing device, electronic glasses that you are seeing, tattoos even doing there, sensor patches and even a cloth that you are wearing is very similar to that.

Here again another way in which you will be able to carry the sensor, you will be able to be the agent in implementing the IoT solution, getting closer to the system that needs to be measured and controlled, if you will. The final one is inside the body, whether in the body or inside the body, bionic eye you can see.

Smart pills that will travel in your internal organ, Smart implants, where it constantly measures the stress that you are putting your organ part into it. artificial limbs and

dental hearing is a very new technology, where an implant is given and you can remotely hear or locally hear. There is various configuration that you will be able to do.

There are lot more is happening in the inside area on the body and closer to the body. So, the wearable is a very important friend to look at. Basically, because in the IoT the edge sometimes you can fix things and come and sometimes you may have to go to the system and operate on that. While you are operating on the system, can you measure it and can you collect the data in a systematic manner, architect solutions or analysis around it.

That is what it is trying to do. So, with this we are coming to the end of the first half of our session and what we have covered here is to recap. So, we understood the fundamentals of IoT, Internet of Things. It consists of sensors, connectivity, and peoples and processes. We understood the IoT platform as we know what are there in terms of generic platform, COTS platform and very vertical specific solutions, if you will.

Then we went a little bit deeper into the wearables and how it is influenced in terms of nearer to our body, and on our body, inside our body and things like that. So, with that, we will move on to the next session.