



The Deloitte On Cloud Podcast

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Title: The power and promise of wearable cognitive assistance

Description: Every so often, a technology comes along that has the power to change how we view and perform in the world. One of those just might be wearable cognitive assistance (WCA) devices. In this episode, David talks with Carnegie Mellon University professor Mahadev Satyanarayanan and Deloitte's Arpan Tiwari about how WCA, via leveraging the edge and AI to augment human capabilities, will transform the way we work and live, and open up worlds of knowledge and ability to anyone who wears a device.

Duration: 00:28:20

David Linthicum:

Welcome back to the On Cloud podcast. Today on the show I am joined by Arpan and Satya. Arpan is a managing director in Deloitte Consulting LLP's Technology, Media, and Telecommunications practice (TMT) and Satya is the Carnegie Group University professor of computer science at Carnegie Mellon University. And Satya, you've been on the show before, so listeners are fairly familiar with you. Arpan, you want to kind of catch us up on what you've been doing and what you do at Deloitte and then we'll have Satya do the same thing?

Arpan:

Absolutely. I am working as a managing director at Deloitte. I focus on business and operating model transformations enabled by technologies like 5G, edge computing, wearables. In my fourteen-plus years at Deloitte, I've had the privilege of serving clients, both large companies and startups across three continents—Asia, Europe, and North America—and very excited to be on this podcast with Professor Satya and you, David.

David Linthicum:

Yeah, it's great to have you here. So, catch us up, Satya. What have you been doing in the last—since you've last been on the podcast?

Satya:

So, as you know, as I mentioned in the previous podcast, I work broadly in the area of edge computing and as it is applied to the internet of things (IoT) and mobile computing. And one of the lines of research that has been very exciting has been this whole domain of applying edge computing to wearable cognitive assistance, so the intersection of 5G, wearable devices, edge computing, and AI algorithms. And that leads to wearable cognitive assistance, which is the focus of our discussion today.

David Linthicum:

Yeah, I'm excited to talk about it because it's something—I love to learn things on this podcast, and that's something I'm definitely going to learn. So, let's get into it. So, Satya, I'll go back to you. So, what is WCA and how does it differ from wearables today? How does it differ from my Fitbit that I'm having my wrist right now?

Satya:

Sure. So, the hardware part is the same. It is a wearable device just like any of the other wearable device, so some of them are things like watches and Fitbit devices. Others are heads-up display like Google Glass and HoloLens. So, the wearable part of it is not different. What is different is how it is being used. So, the Fitbit just tells you what you're doing. It senses your heart rate, it senses other parameters, and it gives you some feedback. Many of these wearable devices are used for giving you information. Your Apple Watch® delivers information to you. And this is also true for augmented reality on wearable devices where it shows you annotations on a work piece, for example. The beautiful thing, the really valuable aspect of wearable cognitive assistance is combining this dimension of wearability, and information sensing, and presentation with artificial intelligence algorithms based on machine learning in the critical loop, in the inner loop of cognition. And that transforms the capabilities of the wearable device.

David Linthicum:

So, Arpan, does this occur in the cloud? Does this occur on the device? Does it occur in-between them, or it really doesn't matter?

Arpan:

Well, it would be a combination depending on the nature of the wearable cognitive automation that you're talking about, or the specific use case in question. You may have essentially some compute that could happen, again, within the confines of the form factor of the device itself. Again, you cannot have a large compute, otherwise the device would be so big that it would be hard for anybody to wear and walk around.

David Linthicum:

And be hot too.

Arpan:

And be hot too, precisely. So, it depends again on the workload, it depends on the use case. So, again, it could be happening on the device, it could be happening inside the premises of a factory, it could be happening on the edge, and if the cloud data centers are close by within the same region, then it could even be happening in those locations. It depends on the nature of the use case.

David Linthicum:

So, wearables technology has been around for some time. I remember I saw a demonstration at MIT years ago, whenever you talk about computers getting too hot. The vest that they were wearing overheated, and they had to take it off really fast as they were showing me and demonstrating the wearable computing stuff, those early prototypes, things like that. So, why do you think the time is now for dealing with WCA and really kind of finding a practical applications for it, and, also, what do you think business needs to look at in terms of leveraging this technology to make a profit? And Satya, I'll go to you first.

Satya:

Sure. The important thing about wearable cognitive assistance is we think there are huge opportunities for productivity improvement in areas such as industrial maintenance, sustainment, even small unit manufacturing where the ability to deliver just-in-time knowledge to the worker, hands-free, in the context of the task is very valuable. And further, using the vision and audio and other sensors on the device to verify that the step has been carried out as it should, adds a dimension that is very powerful. So, this combination of guidance and verification is reminiscent of how our GPS navigation systems work. You tell it where you want to go, it knows the map, it gives you step-by-step directions. If you make a mistake, it catches it right away and recovers—helps you recover from it. Imagine being able to do that in industrial settings, in manufacturing, and all kinds of other domains of life. And that, we think, is the really powerful capability and the potential of this technology.

David Linthicum:

So, Arpan, I love the GPS analogy because if you think about it if we're going on a health journey, for instance—use that because much of this technology's going to be found there. You lose 20 pounds, you get blood pressure down, you'd have better sleep habits, all those sorts of things, and I'm going to go ahead and enter that in as a goal, and it's one thing for me to guide myself there and try to think sync through it versus some sort of an automated assistant-based behavior, the ability to kind of guide me through what it takes to lose 20 pounds in terms of reducing caloric intake and increasing exercise and things like that to get to the objective.

And, so, if you think about that, and kind of the thing was blowing up in my mind, that can go to many different things, safety on factory floors, slip and fall kinds of things, and all the—even driving bicycles and motorcycles which are incredibly dangerous activities, and they could be monitored, and they can be

adjusted based on the behavior of the person, and even the machine. So, there's lots of great things that can come out of this, Arpan, so what's your thoughts here and where do you think this technology's going to go next?

Arpan:

Absolutely. I mean, you laid out a good example of what this thing could do on the consumer side, and the same argument applies to essentially scaling this technology onto the enterprise front. So, for example, in the case of let's say an oil rig, or a refinery, or a manufacturing plant, or even an assembly line, the possibilities are endless. And with one thing the pandemic has shown us is you cannot rely on having the skilled technician or the skilled worker fly about just about everywhere—anywhere in the world. So, if you have a capability where the device is able to see in real time what is happening and guide the worker who's not as skilled as this remote worker that I was alluding to, and correct what the necessary action needs to be to be able to fix something that's broken, or if there is an issue that is likely to occur, can guide a technician to actively fix some of those things. That can go a long way in bringing the supply chain resilience that we talk about and essentially take automation inside these industrial settings to the next level.

David Linthicum:

So, Satya, is there an opportunity here to have centralized learning? The ability to gather information and disseminate that information as knowledge—as a knowledge model and the ability to share that knowledge model with other knowledge models? In essence, we have a big brain in terms of our ability to leverage AI to its full capacity. And, so, instead of just understanding things and patterns around myself and my health, it's the ability to gather larger amounts of information, perhaps even looking at patterns, going back to health, lots of different applications for this, and all these sorts of things where we can actually take preventive action, not only based on the knowledge that I'm building in using my WCA, but the knowledge that is gathered centrally and is disseminated back to people who can perhaps leverage that knowledge in a way that's going to have a much more positive effect.

Satya:

Yeah, you make some excellent points, David. Let me maybe amplify on the expert aspect. As Arpan just mentioned, the ability to go out to a human expert when needed is valuable, but there are only a few experts in the world by definition. Expertise in any field is always scarce. So, the ability to capture at least part of that expertise in software and be able to guide a person without having to use the attention of the expert is valuable. So, only when the software is out of its depth you actually have to go to the real expert.

Further, what this then reveals are ways in which the worker is making mistakes, because if you record the interaction with the expert and you have a month's or a few months' worth of these, you can look for the patterns. When people call in, or when people make mistakes, is there a common denominator? Is there one that they're making frequently? First, can we change the workflow of the task so that that is less likely to happen? Second, can we modify the software so that it can catch it and doesn't need to consume the attention of the expert, and so on?

You gave the example of a consumer context where somebody wants to lose weight, you want the guidance to be given. This might be a healthcare-related app. Well, think about it. Just before you reach for that calorie-filled donut and put it in your mouth, just at that moment, if it could whisper in your ear, "Stop, David, don't do that. Eat an apple instead." That is the kind of just-in-time intervention that could be very powerful.

David Linthicum:

Yeah, and I think if you apply that certainly in driving and operating a motorcycle, operating a bicycle, or doing other things that are dangerous, operating heavy machinery, and we're coming to a point where these sorts of assistance, they're allowing humans to be better, they're allowing humans to be safer, and they're really kind of providing an added benefit for doing any sort of task or living any sort of way. So, my next question, Arpan, kind of goes to we have a changing world, we have cloud computing, we have 5G. Is WCA really kind of inflecting because we have those available technologies, or is it something that you think would evolve by itself independent of those technologies?

Arpan:

That's a really good question. So, if you think about it, for something like a wearable cognitive assistance to be able to succeed, there are a lot of prerequisites, a lot of underlying technologies that have to be put in place. So, one of the things that you already alluded to is the ability to transfer data at very high speeds from the device to a location where there is essentially greater compute power that's available, so it could be on the edge cloud, it could be on the centralized cloud, whatever, but you need the ability to transfer large amounts of data and have that data processed at this location and then sent back to the device in a matter of a few milliseconds, again depending on the nature of the use case.

So, that's where a 5G network comes into play. Now, there are a bunch of other prerequisites as well, so as we talk about miniaturization of devices, you are getting new age devices which have a lot of compute power and storage power built into it, thanks to the semiconductor manufacturing capabilities that have improved over the years, advancements in battery technology, because the wearable devices are becoming power hungry, and so the power packs and everything else has to keep up with that.

A lot of innovation is happening on the software side as well, and something I alluded to, I mean AI and ML capabilities as well, so a lot of open-source libraries that allow the sophisticated AI-ML capabilities, or give these capabilities in the hands of developers so that true innovation can be happening. And then last but not least, pandemic has shown us that you cannot rely on a system that's optimized to the *[Inaudible]*. There has to be some resilience, some capability that's built that allows for disruptions, so a combination of all of these factors I believe will push the WCA to the next growth trajectory.

David Linthicum:

Yeah, I think that's great insight as to how this stuff is emerging and really kind of combining together the technologies kind of driving the technology. So, Satya, I want to go back to you and kind of change gears. One of the things, if I wrote an article on this, and I published it, on the social media post it would come back with privacy concerns. And it seems to come back lots these days, so people are concerned about giving too much away, and if I have a WCA that's on my wrist, or in my car, or on my tractor, or all the other applications with this technology, that there could be a concern that people are doing monitoring in the background, things like that. How do we ensure privacy, and is there a guaranteed way as consumers of this technology that we can ensure our privacy?

Satya:

It's a very good question. Yes, it is definitely the case that in order to actually offer the cognitive assistance just in time, the system needs sensory information from video, from audio, from other kinds of sensors. There's no other way it can offer you guidance, so that's required. The processing can be done on an edge computing node, a cloudlet close by, rather than the cloud. You can have business agreements, or consumer service provider agreements, that constrain how that can be used. And, so, the nature of those agreements is going to be.

Something very important to note is that there is really no requirement for this data to be stored long term. You need the sensor data, you need to process it, you need to act on it, and then the data can be thrown away, because you've already acted on it. So, in terms of capturing vast quantities of sensor data and mining it, et cetera, if an entity does that, that is not something that's really required by WCA, something that they are doing to extract, perhaps monetize, the value of this relationship another way. So, there are going to need to be safeguards in the agreements between users of this technology and the service providers that strike the correct balance. And I think the future will have to evolve these correct balances.

Let me give you just an example. I gave you the example of a factory worker, or an industrial worker. We also used the example of somebody concerned about their health and trying to make behavioral changes. A third example might be a senior citizen. Many people, as they grow older, are forgetful. For vision, they can wear glasses. For hearing, they can wear hearing aids, but once they start having early onset of forgetfulness, dementia, all those kinds of things, imagine a cognitive assistant that could help them stay in their home, perhaps for a few months longer, before they have to be moved elsewhere. That improves the quality of life for them, for their caregivers, for everybody. This is a very different use case of cognitive assistance. The privacy tradeoffs there may be different. So, the point you've raised is excellent and it's an important one. I don't think one size will fit all. I think we're going to have to think through these case-by-case, or context-by-context, and develop best practices that actually are workable.

David Linthicum:

Yeah, I think it's a great point you made because there's no reason to persist the data, and certainly for dealing with devices that aren't huge unto themselves, we don't want to have a lot of storage, so the data can be transitory. And by the way, the data's anonymized. I'm not tagging my heart rate data all the time with my personal information. We can keep that separate, and folks who deal with security understand how to do that all the time. And, certainly, you deal with legal compliance, you're dealing with anything health related. It's always a good practice to start separating information. So, it's probably something people shouldn't be scared of

So, Arpan, back to you, and let's say I have a lot of young people and people changing careers who listen to this show, and they're sold on WCA, they want to get into this technology, they want to work for companies who are building it, they want to work for enterprises that are leveraging it. What training and what experience, kind of a pathway, would you recommend to them to figure out a way to get into WCA?

Arpan:

Absolutely. So, my advice for anyone who's looking to make a career in this space would be essentially just—I would say just starting out of the gate, be curious. Don't take anything for granted, and given that this ecosystem, the whole wearable ecosystem, is a very broad landscape. I mean, just to mention some of the people that you'll encounter as you navigate this journey, you will have people who make the devices, right. So, this could be the device manufacturer. You may have to connect with folks that come from the 5G world or the wi-fi world, and you'll have to talk to the cloud providers, you'll have to interact with the edge providers, and the list goes on and on and on.

What I'm trying to get to, is the ecosystem that is required to be put in place for this technology to have its full impact on human society, the practitioner, or practitioners, would have to have a mindset where they're able to learn fast and in a very broad landscape, given that the amount of players that are likely to be in this ecosystem, so you should have the ability to look across silos, look across horizontally on a broad plane. But at the same time, when you are encountering or solving a specific problem statement, then you should have the ability to dig deeper into that technology, so that you're able to build something that is meaningful, something that adds value. So, you should have the ability to dig deeper when you need it. And, again, don't be afraid of asking questions. Don't be afraid of challenging yourself and I think you will do well.

David Linthicum:

I think that's great advice. So, Arpan, I'll go back to you. Any standards emerging in this area? Seems like any kind of a technology change, there's always a set of organizations and standards that emerge around this. Anything that we can look at today to learn more about WCA?

Arpan:

So, again, there are multiple standards, again depending on which part of the ecosystem you are looking at. So, for example, all things relating to the 5G networks you would have essentially the *[Inaudible]* standards or 13, 14, 15, 16, and 17. And then in the future we'll have at least 18 and 19 as well coming out. So, you'll have essentially standards that talk to the 5G ecosystem. You'll have standards from an IOT perspective. You will have standards, again, like as laid out by standards bodies like NIST, and you talked about privacy. There is a whole privacy framework that NIST has published out so that you can have automation and wearables and broader things as well, but you can capture the data and process the information that's required for that use case within the confines of what privacy allows. So, there are going to be multiple standards in this entire ecosystem that we'll have to stitch together to solve a particular use case.

David Linthicum:

So, Satya, go to you and let's put on our forward-looking hats. So, say this technology in five years, what do you think we'll be looking at there, and what are the core benefits? Are we going to end up being a society where everybody's wearing wearable devices? And I kind of see that today. Everybody has an Apple Watch®, or a Fitbit, or carries a phone, and you might as well turn these into WCA devices because it adds some additional capabilities. And also, what are the additional capabilities that we'll start to see that aren't around today that'll start to be applications for WCA moving forward?

Satya:

A very good question again. I think the way to ask this question is the following, which is while we can envision many, many different scenarios, and Arpan has identified many of them, the highest payoffs are going to be the ones that are the initial drivers. So, I think there are two areas where the payoffs are very high. One is in industrial troubleshooting. When an aircraft at the gate is delayed, when a factory floor is stalled because something breaks down, the value to fixing this faster, the value to getting it moving is high. And, so, these are the kinds of low-hanging monetizable opportunities where quantifying the

benefit is obvious. Every minute the factory floor is down, you can see how many dollars you have lost, and even an imperfect implementation that helps to eliminate friction in the workflow of getting things moving again can be valuable.

So, that's one domain, and the other as I said is elder assistance, elder care because there the win is huge. And I think these two drivers driving the underlying technology, so wearable devices, 5G, edge computing, that will move those technologies forward where additional use cases become possible and monetizing them becomes feasible. And, so, I see this kind of virtuous feedback cycle emerging. Bootstrapping it is usually the hard part, but I think these domains that I just mentioned are the ones which, if I look at the five-year horizon, that's where I think the wins are going to be.

David Linthicum:

Excellent. I love this technology because it is something that can really add a great deal of value to humanity without a lot of money, and so there's not a lot of money being risked, we have a huge amount of value that comes back. So, Arpan, I understand you and Satya wrote a paper, and can you tell us a bit about that paper? We'll put a link in the description but like to send all the listeners out there to give that a read.

Arpan:

Absolutely. This is something that is near and dear to us, which is basically how do you take the advances in technology, so miniaturization of devices, better and capable high-speed networks like 5G, availability of edge computing nodes, better improvements, or overall improvements in how software gets written, how distributed computing is sort of like now available to all of us. So, how do you take all of these technologies and infuse them in an application or, in a form factor, where you are taking a certain capability that requires, again, some specialized knowledge, some specialized trade craft, and you can disseminate that information, that knowledge to a less equipped, or less trained worker, and how can you use that worker to then perform the activity that a true expert would have been relied upon.

So, again, like as Professor Satya pointed out, experts are far and few because of being experts, right. I mean, you can't have everybody who's an expert at everything, so how do you take essentially this collective wisdom from a small group of people and federate it out so that you are able to make the impact where it truly, truly matters? So, that's how I would say like society has evolved over the last several decades, centuries, and millennia, and this is basically going to be the engine in my mind that continues to evolve humanity for the better.

David Linthicum:

Yeah, I think so. So, you check out that link and read that paper because it has some great stuff in it. This is new technology, valuable technology, and if you're into cloud computing, and edge computing and IOT, things like that, this is really where the technology is moving to. And it's going to affect a lot of spaces too, the ability to bring intelligence to vehicles and all these sorts of things that are kind of changing our lives every day. So, Satya, where can our listeners find out more about you on the web and maybe see additional work?

Satya:

Certainly, you're welcome to [view my website](#), you're welcome to see the papers that I've published. They're all available on my website, and they're all available publicly, so I'd be very happy to share them. They're also welcome to contact me, and I'll be happy to respond to them.

David Linthicum:

All right, we'll put that link in the description. So, Arpan, same question. Where can we find out more about you on the web?

Arpan:

LinkedIn and Deloitte.com. Those would be my two go-to areas.

David Linthicum:

Both smart guys. Tell you what, this is where the technology's going, and if you want to learn more about this technology and follow it moving forward, make sure you follow the research that Satya's doing, and some of the work that Arpan's doing, and some of the stuff we're doing here at Deloitte in terms of how we're going to take this technology to the next level. So, if you enjoyed this podcast, make sure to like us, rate us, and subscribe. You can also check out our past episodes, including those hosted by my good friend, Mike Kavis. Find out more at [deloittecloudpodcast.com](#). And if you'd like to contact me directly, you can e-mail me at dlinthicum@deloitte.com. So, until next time, best of luck with your cloud journey, and everybody stay real safe. Cheers.

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