

The New Humanoids

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Christoph Bartneck: [00:00:00] Hi Dwain.

Dwain: Hi, Christoph.

Christoph Bartneck: What you got for me this week?

Dwain: Well, I've brought a BBC clip from 1966 about the amazing Abel Mabel robot.

Christoph Bartneck: Okay, let's play it

BBC: show his lordship in, Mabel. Introducing Mabel, the robot housemaid. Begin the day with Abel Mabel. She'll wake you at your preset time. She'll bring your morning tea, brewed just how you like it.

She's great at a party. Her cocktails are classical, and it's safe to drink and drive, for she also computes your blood alcohol level. With radar and sonic sensing, she's both babysitter and burglar alarm. Free your wife from domestic slavery. Let her command her own slave at the touch of a button.

Meredith Thring: You may think that this is a wild [00:01:00] pipe dream, the idea of a robot housemaid. Well, it isn't. And in order to prove this, I've made this half scale model of what I would regard as the necessary working parts of a real robot of this type. All the technological problems of developing the domestic robot can quite definitely be solved. There's only one outstanding problem, and this is it would cost about a million pounds to develop the first working prototype, and we haven't got the million pounds.

Christoph Bartneck: Who is the inventor promising to build the robot?

Dwain: It's Professor Meredith Thring. He was a futurologist back before there was a futurist on every corner.

Christoph Bartneck: Did he ever get his 1 million pounds?

Dwain: Not that I'm aware.

Christoph Bartneck: Did he ever build Abel Mabel?

Dwain: Not to my knowledge.

Christoph Bartneck: Okay, the engineers will certainly have learned their lesson from this and stopped promising robots they could not build. Right?

Dwain: Well, I have a second clip for you.

Christoph Bartneck: [00:02:00] And who is it from?

Dwain: From someone who many would call the most important inventor alive, Elon Musk.

Christoph Bartneck: Okay, bring it on.

Elon Musk: when you think about the, our, the Optimus. Uh, robot, which is really a humanoid robot that is intended to, um, you know, be able to do anything you wanted to do to be, uh, you know, it's, uh, you're, you know, your companion, it can be at your house, it can sort of, uh, babysit your kids, it could teach them, uh, be a teacher, um, it, it, you know, it can do factory stuff.

Christoph Bartneck: What would the Optimus robot mean for Tesla?

Dwain: Here's Musk again.

Elon Musk: We do think we will have Optimus in limited production in the factory and the actual factory itself doing useful tasks before the end of this year. I think we may be able to sell it externally by the end of next year. These are just guesses. As I've said before, I think Optimus will be more valuable than [00:03:00] everything else combined. Because if you've got a sentient humanoid robot that is able to navigate reality and do tasks after class, there is no meaningful limit to the size of the economy.

Christoph Bartneck: So Tesla is no longer a car company, but a humanoid robot company?

Dwain: So far they have two of them working in their factory.

Christoph Bartneck: Would a robot arm not be better at that job?

Dwain: Well, we don't know what exactly the job is, however it's not just Tesla who creates humanoids. Here is Andrea Campbell from Agility Robotics.

Aindrea: This is the world's first humanoid robot factory. This has never been done before. It's a brand new building, about 70,000 square feet, and it'll be able to deliver over 10,000 robots a year at max capacity. There was a point in time over a hundred years ago when we had the world's first automobile factory. I think this is the same moment where we are now [00:04:00] having the world's first humanoid robot factory. And someday, just like automobiles, humanoid robots will be all around the globe.

Christoph Bartneck: Mass production of humanoids. Wow, that sounds promising.

Dwain: And here is Brett Adcock from Figure Robotics.

Brett Adcock: We hope over the next 12 to 24 months we're starting to have real robots in real facilities at our clients. I think once we start seeing robots in the real world, doing everyday tasks, helping humans, doing real work every single day, it'll feel like 30 years of the future, 50 years of the future is pulled forward. It'll be pretty magical.

Christoph Bartneck: And we've not even covered the army of new humanoids from Unitree, Tiangong, Meteebot, or Rainbow Robotics. Hey, even Apple is rumored to be working on a humanoid.

Dwain: That would be the iRobot.

Christoph Bartneck: That name's already taken.

Dwain: Oh well, what do the experts say?

Christoph Bartneck: Let's find out.

This is the Human Robot Interaction Podcast. [00:05:00] Your

host, Christoph Bartneck.

Will Jackson: It's actuation is the really big one. So we don't have anything with the power to weight ratio, speed, force, fidelity of biological muscle. Electric motors, hydraulics, pneumatics, there isn't anything that really competes. And this is a big problem. It's a blocker.

Christoph Bartneck: This is Will Jackson, CEO and founder of engineering arts limited.

Will Jackson: Try and be aware of yourself as you pick something up. So go reach for something on the table. And what you'll find is that your hand, your arm goes into almost this like floating like state. You're very compliant, very soft, very gentle. But once you [00:06:00] grab the thing that you're interested in, you transition fairly instantly to this much more rigid state where you can then manipulate the object to do what you want with it.

If you see a robot, that's, strain wave gears, harmonic drives inherently those kind of drives can't do that. They can't. Get into this relaxed compliance state, which means if you're trying to emulate human capabilities You're just not going to get there and it doesn't matter how much ai you chuck at it You're not going to make a brick fly. So I see this all the time. Hey, it's just an ai problem I'm going to solve it with chat gpt You are not going to solve mechanics that suck with chat gpt, it's just really dumb.

Robert: Those humanoids which have been developed so far are not good in humanoid functions. So the robots we have nowadays are good in very specific functions, such as [00:07:00] walking, running, doing hand tasks, grasping tasks.

But as soon as we want to have a robot which is able to fulfill a versatility of different tasks, they are failing. On the other we have great structures, great components, such as technical eyes or cameras, technical ears or microphones, great motors, batteries, and computers. It seems that we have not been able yet to connect these components to one system which is performing better than the human.

My name is Robert Riener. I'm professor for robotics at ETH Zurich in Switzerland.

Dwain: What can the humanoids reliably do right now?

Will Jackson: So what works really, really well is human interaction. And I think this is true for all humanoids. What is the killer application for a humanoid? I think I'm qualified to speak on this because I've been selling [00:08:00] them for 20 years.

So I know the applications that have worked and I know the applications that don't work. It's generally always people centric. It's about interfacing with people. It's about communication with people. It's about entertaining them. If you have a look at some of the other companies Boston Dynamics, fantastic.

What amazing work from Mark Rayburt and team, amazing things they've developed. How many humanoid robots have they deployed commercially? None as far as I'm aware.

Robert: Boston dynamics is a great robotics company. It's probably still the best, I would say. But what I know from the former CEO, Mark Reibert, is, and he admits it also publicly takes them several repetitions until the robots move as we see them moving in the movies. They're not faking the movies. They are having several engineers in the back, programming the machines and optimizing them.

And it takes a lot of repetition that they can move [00:09:00] in that spectacular way if you see it, that they can even do saltos and do amazing performance. Maybe it appears even better than humans, but it's still a specific kind of movement they can do. And what we also have to take into account is that these move robots are moving in structured environments. So the robots knows the step height and the scenario. And if there's some obstacle laying around or coming another robot or human, they would fail.

Will Jackson: We've now got the new version of Atlas. Is that going to be wandering around factories? I think you're much more likely to see it wandering around the theme park.

Robert: The humanoids which we have nowadays are fascinating. They can do maybe more than the humans because they have different joints with larger ranges of motion. Maybe some of them might be able even to run faster soon. As soon as we change some of the components and make them less humanoid for example, replacing the legs by wheels, they can for sure outperform [00:10:00] humans.

Will Jackson: You've got to know what the application is. If I want to go into a factory and I want to do some factory automation, is a human form, the best form to do that. If I want to move stuff from 200 meters away down the other end of my factory up to this end, and I want to do it continuously and fast, there's a thing called a conveyor belt. It's been around a while and it works pretty well. And you can end up with a very, very fast very efficient factory automation system for warehousing, distribution, picking place of goods, etc. So then go and have a look at a humanoid robot trying to do the same thing.

Well, A, it's not as fast as a human. And even if it was human equivalent, a human wasn't the best way to do it in the first place. When you go and look at a robot welding on a production line, did they make a humanoid with short little arms that can lift maybe 50 kilos?

No, they made a massive thing with huge [00:11:00] long arms. There's super position accurate that can lift a giant welding head and can operate 24 seven. Why would you try and emulate the thing that was not very good to solve the problem? Now, why be human when you can be superhuman?

Christoph Bartneck: Elon Musk made the claim that his Optimus robot will enter production very soon. Is that realistic?

Robert: I think it's realistic that the robots which we have nowadays, such as Optimus from Elon Musk, is able to take over certain tasks, very specific tasks. I doubt and I'm quite sure that it will still take a long time until the robots are able to take over a large selection of different tasks. That they show certain versatility as we do have it as humans. So it will still be very specific tasks. In these tasks, the robots might be able to outperform us. But there are many other tasks, complex [00:12:00] tasks, for example, carrying objects over stairs in busy environments where we have maybe several humans can be very challenging. all robots I've seen so far, including Optimus, does not perform that convincing that they might already outperform humans.

Christoph Bartneck: And what role do large language models play for humanoids?

Robert: Large language models are one subgroup of machine learning algorithms. Machine learning is already used in robotics since several decades. We're using machine learning such as neural networks, and nowadays also maybe deep learning methods to let them better move to learn from the environments in certain scenarios in interaction with humans, for example or with objects and environments.

The algorithms are enabling the machines to learn from certain scenarios. So that's machine learning, which is already being used since a long time. Now, with the large language models, [00:13:00] we can use them for better communication of the robots with humans. And we know this already from existing devices such as Siri or Alexa that this can make, or currently it's possible to enable quite good communication between robots and humans.

Will Jackson: Yeah, language models are a massive thing. Suddenly we can do conversational interaction. language is a tool of humans. It's our communication method.

Our conversational interaction, emotional interaction, is gestures, is expression those things. That's where you can actually have a functional business model at the moment. So yeah, language models are huge.

Dwain: So why do you think so many Of these companies have started coming out and focusing on working on humanoids in the last few years. Do you have any thoughts on why that's happened?

Will Jackson: Yeah, it's kind of interesting, isn't it? So we've been through several waves of this. I guess language models, AI, computer vision, deep [00:14:00] learning, all of those things have kind of sparked people's imagination.

You can talk with a machine and you get a sensible conversation back and you can start to see that, machine can identify objects and maybe start to manipulate them in some way. And that's quite intriguing. It's kind of a sci fi idea. So it's the future made real.

Robert: We work already on human rights since quite a long time. The first human rights have been existed already almost 300 years ago when watchmakers very professional moving machines, humanoids, which could do mechanical or movement tasks in a very realistic way.

There was always a fascination for machines which appear like humans. And in the last five to 10 years, I would say that the technical components that get much better, also affordable, for example, computers [00:15:00] are more powerful to be able to let the machines. Move in a controlled and reliable way, then we have much better camera technology, sensing technology and especially also battery power.

we have more efficient batteries and also more efficient and stronger motors. So the single components did get much better in the last five to 10 years. And now it's just a question of some more time that we will be able to combine these units to more complex systems to whom it's which will then also sooner or later perform as humans and probably also will outperform humans.

Christoph Bartneck: Is that integration hell?

Robert: Yes, exactly. It's a challenge to integrate things into something which is really functional and still doesn't need more space as we are needing in our daily life environments

Will Jackson: So if you think about [00:16:00] our technology and its progression, it's, we tell ourselves stories. So there's this kind of collective imagination, if you will. go out into the street, find a few people and ask them, you know, what will you see in the future? Yeah. That you don't see today, so they're going to say, Ooh, uh,

you know, I'm gonna have a flying car. I'm going to have a hoverboard. I'm going to have a robot servant that brings me beer out of the fridge.

And these are the kinds of things that people will talk about. So it's in the collective imagination. So what tends to happen is those things are made real because of that kind of collective imagination, because of that desire, not because it's a great business plan, but because people kind of. Believe in it or they dream about it in some way.

Christoph Bartneck: In what domains can humanoids operate?

Robert: Humanoids can operate in all domains as we can operate. That's also the idea [00:17:00] of the humanoids. If we change some of the structures and the appearance, they can also operate in other domains such domains, which maybe are too far away for us or too dangerous. For example, on Mars or in the deep sea, we can have humanoids or robots at all. in dangerous areas, in war areas, in, or for search and rescue tasks.

Will Jackson: Uh, oh, it's gonna rescue people. It's gonna be search and rescue. Now this one always comes up, what's the robot for the search and rescue? Why is this good? Because it's saving lives. And I'm Oh, you can't go against something that's saving lives, who are you, some terrible person that doesn't believe in the value of human life, so that one is always the one that comes straight up is it's search and rescue is going to save lives.

A lot of what we see with robotics in a minute they're fabulous to solutions to problems that don't [00:18:00] exist. So, you've got a bunch of people having fun going, Hey, we could add wheels and wings onto it, and we could make a fly wheely drone submarine. Yay! What's it for? Oh, uh, you know, they're starting from the point of, hey, we technically we could do this, but they never actually think what problem are we solving?

I think you saw that a lot with Boston Dynamics. My guess is there's less than 2000 spots in the world .I'd say there's definitely less than 10, 000. Now that's a tiny number. For the 30 years of research that went into it, really, and they, and you look at the kind of proposed applications, okay, it's, uh, it's going to be in a power station looking at an electricity gauge, uh, you know, there's a thing called a remote sensing gauge, you've been able to buy them for 30 years, you don't need a legged robot to go look at a gauge that was designed for human history, just replace it with some [00:19:00] electronic sensor, you know, it's, it's done.

Robert: If you have a robot which can only make a shake, then we don't need a human robot. Or if we need a robot which is only cleaning the dishes when we have our dishwashers. If we have robots just to carry objects from one room to another room, we can take a wheeled machine.

But if you want to have humanoids which are able to support us in a certain, more complex environment. With a number of different tasks, then we need better machines, and that's still a challenge, and that will take another 10, I would say 20 years at least. What we have to take into account is the following.

Will Jackson: who's doing the best on that probably at the minute is Tesla because they've got a great bunch of engineers. They've got deep pockets good resources They've got a lot of drive behind them and they're putting their humanoids to work on in factory use cases. Now is that an efficient piece of automation? No, do [00:20:00] they know it? Yes, of course, they know it. Is it a way of training robots for doing other things? Yes, it's a useful test environment, and they happen to have the car factories at their disposal to do it.

If they were Tesla, the customer going to another company that make humanoid robots, and they were looking to solve automation processes on their production line, would they buy humanoids? No, the hell they wouldn't. You'll see other car companies that are all flailing around trying to imitate it.

So you'll see, BMW, Mercedes, whatever all demoing. There was one of the Chinese ones was demoing humanoids on their production line. And you'll see them doing just ridiculously silly tasks, like sticking a badge on a car at the end or something. It's all about, it's performative, by the way, it's all about the show. If you want to stick a badge on a car, a pneumatic piston does a really good job. Yeah, so it's just show, it's just performance.

[00:21:00]

Conclusions

Christoph Bartneck: the visions for our robotic future that Elon Musk and others proclaimed are

not new.

Dwain: You're right. Since the 1950s, science fiction authors such as Isaac Asimov have described a future in which an endless array of robots do all the work for us.

Christoph Bartneck: I think he predicted a ratio of 1 to 20 between humans and robots. How many robots are helping out in your home?

Dwain: Zero. Unless, of course, you consider a washing machine to be a robot.

Christoph Bartneck: Well, it's a peacemaker. Still, humanoid robots are also nothing new. Honda's Asimov humanoid started walking around 24 years ago.

Dwain: Yeah, there has been what seems to be considerable progress. For example, the New Look Atlas robot from Boston Dynamics boasts some impressive acrobatic skills.

Christoph Bartneck: Yes, but we are vulnerable to the first step fallacy, a more general planning fallacy variant. [00:22:00] Early successes lead us to make predictions that are too optimistic for the future.

Dwain: Robotic companies make these optimistic predictions fully knowing that they'll not be able to deliver in the foreseeable future. They have to weave a compelling, though somewhat deceptive, narrative to attract investors. Fake it until you make it and whatnot. You get enough of these companies doing this, think AI right now, and it tends to trigger the bandwagon effect amongst investors. Everyone just wants in.

Christoph Bartneck: Elon Musk is already wildly known to take some liberty with his predictions. Fully autonomous robot taxis have been just one year away for several years.

Dwain: Hmm. On August 8th, Tesla will have another opportunity to prove us wrong.

Christoph Bartneck: What strikes me is that the robotic future story is so seductively clear. Who would not want to have a Mr. Data at home? Here, listen to Musk.

Elon Musk: Uh, I think, I think everyone in the world is gonna want one. Like, literally everyone. I'm [00:23:00] confident of the prediction that there will be more. More, uh, like the ratio of Humanoid robots to humans will be greater than one-to-one. Um, so that there'll be, you know, more than 10 billion humanoid robots in the world. Um, probably 20 or more.

Christoph Bartneck: It is also extremely simple to define our goal. A robot that works like a human.

Dwain: Science fiction has given us so many examples. Musk often refers to fictional robots from movies.

Elon Musk: Like, who doesn't want a C3PO, you know? Um, uh, you know, but a C3PO plus R2D2 plus, you know, plus plus. Um, it would be pretty awesome.

Christoph Bartneck: We just completely underestimate what it means to be human. Tasks that are simple for humans turn out to be almost impossible for robots.

Dwain: Instead of making robots human like, it would be more effective to create robots that work reliably in whatever domain they're designed for. Rolling on wheels, for [00:24:00] example, is so much easier and more reliable than attempting to have a robot walk on two legs.

Christoph Bartneck: Not surprisingly, Boston Dynamics first robot that has a chance of wide adoption in the industry is Stretch, a robot arm on wheels. Their far more famous robot Atlas is not available for purchase at all. They developed this robot for 30 years without bringing it to the market.

Dwain: Yeah, it could be argued that Boston Dynamics business model for Atlas is out of a YouTuber. If Mr. Beast can make an outrageously successful business from creatively giving away millions of dollars, then conceivably, a robot manufacturer could spend millions to make a robot dance, right?

Christoph Bartneck: There are some undeniable limitations. What good is a robot that can only operate for one hour before having to recharge? How useful is a robot that cannot operate safely in the presence of humans or animals?

Dwain: Unstructured environments such as those in which humans work and live are incredibly difficult for [00:25:00] robots. Objects and people constantly move around. Unpredictable situations arise that robots have not encountered.

Christoph Bartneck: Humans can fall back on common sense and intuition. Robots cannot.

Dwain: Well, unless a human operator is controlling the robot in the background. But then you might as well pay the human to do the task.

Christoph Bartneck: The robotic companies make these brave predictions about our robotic future. They have to. They promise bright new futures so that they can collect billions of dollars from investors.

Dwain: I don't mind if investors fall for these fantasies. Giving a company hundreds of millions of dollars prior to them ever selling a single robot is really just rolling the dice. They may win, they may not.

Christoph Bartneck: What I do worry about is how this over optimistic view is setting up the robotics community for a major disappointment. The general public and funding bodies will lose trust in our work.

Dwain: I agree. Convincing them to continue to support research will become increasingly difficult.

Christoph Bartneck: How many people still believe that the metaverse will be our [00:26:00] future? How much time did you spend in it?

Dwain: Zero.

Christoph Bartneck: How about big data? Internet of Things, 5G? I can use any tech buzzword you like. If you enter the hype cycle, you will have to face the backlash.

Christoph Bartneck: We will continue our inquiries into humanoid robots.

Dwain: There's just too much to talk about.

Christoph Bartneck: Automatization has been progressing since the industrial revolution. We have been promised that this will give all humans more prosperity and more free time.

Dwain: I'm skeptical that this will happen. We'll still work long hours.

Christoph Bartneck: So join us next time when we talk about the economics of robotics and what this means for the job market.

[00:27:00]