The Citi Institute Podcast

CIP The Rise of AI Robots
Host:
Alex Miller
Guests:

Shenwei Zhu	Managing Director, Investment Banking Division, Citi
Felix Zhang	CEO and Founder, Pudu Robotics

Title - CIP The Rise of AI Robots

00.00
Alex: Hi, I'm Alex Miller. And this is the Citi Institute podcast, where we explore the forces shaping finance, the global economy, and the way we live and work.
In each episode, we bring you insights from thought leaders and innovators driving change, helping you stay informed, navigate challenges, and seize opportunities in a rapidly evolving world.

Wrap up Quote 1 - Shenwei Zhu, Managing Director, Investment Banking Division, Citi

00.20

How do you get robots to work together, understand the function they're trying to perform and communicate directly. It's sort of is the next phase of the development, right?

Wrap up Quote 2 - Felix Zhang, CEO and Founder, Pudu Robotics
Felix Zhang

Robotics company really needed to focus on technology and product - that is the fundamental of a robotics company.

I think passion and the long-term things is, are very important.

Every technology company has to l- listen carefully to your customer, uh, work with your customer, uh, or co-deve- develop robots with your customer.

Alex:
00.58

Today we are hosting a discussion about the cutting edge field of robotics. AI robots can now see, learn, move, talk, and take instruction into code and then act. Only recently has multi-modalized AI allowed all these elements to fit together. In the Citi report, the rise of AI robots, our analysis suggests there will be a four-fold growth to more than a billion AI robots by 2035 and twelve-fold to 4 billion by 2050. We're thrilled to have with us to discuss this, - founder and CEO of Pudu Robotics, Felix Zhang, and Citigroup's Shenwei Zhu, who are here to share their views on this emerging space. Felix, thank you for joining us. Tell us first for you, the- what was the eureka moment in your founding of the journey as you approach next year, I think what's gonna be your 10th anniversary since founding Pudu Robotics.

Felix Zhang
01.59

Thank you, Alex. Uh, so we got close to the, uh, ten-year anniversary of Pudu Robotics next year. People often, often ask me that Eureka moment is in founding the company, honestly, started, uh, way back in college. I've always been a huge fan of robots. After graduation, I jumped o- into my first startup, uh, where we worked on flying cars. Then I built a tech media company or something like TechCrunch in China. After that, I started my third company, a consumer robotics venture. Uh, that one lasted over three years, but in the end, uh, it didn't work out. It failed. Uh, that failure made me rethink everything. What should I do next? What the robot I really want to build, uh, what robot can actually create a real value? Here's the Eureka moment. I realised the commercial service robots were the answer, uh, big- because it, it has big market, uh, but no good products existed yet.

So in 2016, I started Pudu Robotics, uh, with restaurant delivery robots. Uh, we, we, we got, uh, traction fast and, uh, open up the, the space. Uh, fast-forward, forward to 2021. Um, and we noticed that something fascinating our customers. Hotels, malls, shopping malls, places already using our delivery robots started asking us that, uh, they want cleaning robots as well. Uh, the core technology for both robots were similar, so we said, why not? That- that's when we began our second curve commercial cleaning robots. Uh, by 2024, uh, since [inaudible 00:03:03] again, we have sold a lot of cleaning robots to factories and warehouses, and those customers, uh, came to ask us- ask us again, "Can you provide industrial delivery robots as well?" So we sort the chance right there. That's why we started developing our third curve industrial delivery robots. It's all about listening our, our customers' needs and agreeing from that.

then in the second half of 2024, we hit a big brief break- breakthrough. We launched some innovative robot designs like semi-humanoid robot, PUDU D7 and, fully humanoid robot, PUDU D9. These are pushing the boundaries, uh, bring a whole new level of smart technology to the market. Uh, looking back, that shift to commercial robots in 2016, that was a moment that set us up for everything we are doing today.

Alex Miller
04.21

That's fascinating. And obviously, you're one of the largest robotics companies in the world, but you started in the restaurant space. You moved into the cleaning space particularly.

Felix Zhang

Yeah.

Alex Miller

And then more recently, the industrial space and now the, the humanoid space, which obviously is particularly interesting.

04.43

Shenwei, maybe I could ask you, I know recently Citigroup hosted a, a major robotics, uh, conference, um, coming after that. Uh, what what was your sort of main takeaways? Whatwas the vibe?

Shenwei Zhu

04.53

Yeah, so we recently hosted our conference, ourrobotics and physical AI conference, uh, last week because this is a third year there that we, we hosted a conference in New York City. We had 30- about 30 presenting companies participating. We have about 50 investors and 120 individuals in total. Um, you know, out of the conference, I think the key themes is A, there is tremendous amount of interest, uh, in this space, particularly given, uh, the broader interest around AI, uh, and what, uh, you know, NVIDIA, Tesla or Jensen and, and Elon is talking about around physical AI being sort of next frontier. Um, if we think about, uh, you know, what ChatGPT has done, potentially for

all sorts of, uh, white-collar, tech jobs, and taking that breakthrough in AI and apply it in the physical world, uh, sort of is the next frontier, right?

That's why there is a lot of interest, uh, from a, from an investor perspective toLearn and to meet with, um, some of the most innovating companies that, that, that came to our conference. Um, you know, I would say, um, the physical AI generally speaking, is still in the very early stage, um, of, of its development. Um, physical AI model is, uh, is more complex, um, than the large language model that I've been talking about. Um, you know, the other thing is availability of data that that's used to train these, uh, physical AI models. Uh, unlike the language models where you have, uh, tremendous amount of data available to train, in the physical AI space, availability of data, uh, is something that people are, are- or need to need to solve first, right? So there isn't, isn't, uh, that that great amount of robotic data available to train.

So people are obviously, uh, deploying robots, uh, collecting data, users to train. People are developing very, um, in- very innovative technologies and, and techniques to, to, to train that- to train the robot, including, uh, using virtual simulation. The media invests a lot of money in the Omniverse, um, um, uh, and type of approach to, to really train, you know, using simulation, using the virtual environment, uh, to train robots to learn the physical world.

So there are many, um, a lot of interest, we see a lot of capital going to the space, um, but still very early stage, um, just given where the overall development of physical AI is, um, you know, the robotic space, I think it's on the- in the dawn age of, um, of, of the next evolution, I would say.

Alex Miller
07.44

Pudu Robotics, Felix, for you, has been a, a, an, an incredibly successful company, you know, over the last decade. But as you think about the, the journey of the last 10 years, you mentioned a pandemic, you mentioned-taking your technology into different areas. Was there anything else that, that, that sort of gained huge new traction? You mentioned the humanoids, uh, as your most recent launch. That must be-

Felix Zhang
08.08

Yeah

.

Alex Miller

... pretty exciting.

Felix Zhang

I think the, the first was in 2017. Pudu was founded in 2016, and in 2017, our first delivery robot won the, the Red Dot Award, the best of the best. That was huge b- because, uh, suddenly the media started covering our story and, uh, a lot of customers reached us, uh, wanting to use our robots. That was the first big step. And, uh, from there, as we launched, new products one by one, our revenue grew fast.

Uh, I think the real turning point, uh, came in 2023 with our mature commercial, uh, cleaning robots. Unlike delivery robots, which mostly they serve the restaurants and hotels, uh, cleaning robots fit almost everywhere. Office buildings, factories, warehouses, supermarkets, shopping malls, hospitals, schools. So our customers became jumped to hundreds, even thousands times, times bigger. We got big names on board They are using our cleaning robots for, uh, floor cleaning now. Uh, then, then moving 2023 shift us from, uh, restaurant folks company to one that serves all kinds of things with, uh, all kinds of service robots.

Alex Miller
09.21

That sounds fascinating. So really sort of noting the way in which, uh, the broader customer opportunity is increasing as you've entered into the commercial space. Um, you, you've mentioned a few technologies. Artificial intelligence is one, manifestation into physical robotics, uh, is, is, is another side of that. When you think about AI's potential and the bionics that, uh, are improving, how good do you think these robotics are gonna become? And do you think we'll just think of them as other people in, in a sense in, in the future?

Felix Zhang
09.58

I really think so. First is, is interaction with large language model technology. V- voice interaction with robots gets super natural. For example, if you go to a supermarket, you can just say, "Hey, I want you buy something." Then the robot pops up a few choices on the screen. Youjust need to swipe to pick the, exact product, and then the robots will lead you to the shelf. That's a huge boost for users.

Second technology is manipulation. The biggest chance with humanoid robots is using robotic arms and robotic hand to do tonnes of tasks in the physical world, uh, uh, like grabbing goods, assembling parts, or even working, uh, in medical, uh, equipment. That's where it, it, it gets exciting. And the third, uh, technology, uh, which I was exciting about is indoor autonomous driving. Uh, this year, this year is almost every autonomous driving and electric car company has started building end-to-end autonomous models. But in the robot industry, no one has really done that yet. I think Pudu will be the first robotics company to launch indoor end-to-end autonomous driving technology probably in, in this July or August. So, so all of the, all of the, uh, advanced, uh, e- emerging technology like, uh, large language models, uh, uh, powering embodied AI, that's, th- that is what's shaping our roadmaps, smarter interaction, better manipulation, and, uh, next level indoor m- mobility.

A**lex Miller**
11.36

I, I love that example you, you give there, Felix, of going to the supermarket and wanting-
Felix Zhang

Yeah.
Alex Miller

... to find out which aisle something's in, because that's a real-world problem. You just can't get someone-
Felix Zhang

Yeah, yeah.
Alex Miller

... to speak to and to tell you where to go to. So I'm sure lots of people would, would, would, would, you know, welcome the opportunity to get a, a humanoid to, to point them in the right direction.
Felix Zhang

Mm-hmm.

Alex Miller

11.55

Um, Shenwei, maybe I could just ask you, you know, you've been deeply involved in this space, and Citigroup have been deeply involved in different ways supporting innovation. Where, where do you see the kind of the, the growth trends, uh, and m- maybe the industries or technologies that, uh, are, are getting, you know, most interest, most traction?

Shenwei Zhu
12.12

Um, yeah, I think, I think, you know, similar to what Felix said, um, you know, there is going to be, um, a lot of progression in the l- next decade or so. I, I think there are really two paths, uh, that this, this technology and, and, and industry is developing. One is, I think you see there's, um, um, people, like, developing robots, uh, with what we call a very focused or single-use case deployment, right? So these are technologies like the, you know, maybe are doing guiding people, uh, in supermarkets to a different aisle. Maybe people are doing-

And guiding people, uh, in supermarkets to a different aisle. Maybe people are doing robots, doing, uh, picking in the, in the warehouse. Uh, they're moving which, um, boxes around in the warehouse. Um, but these are, but these are very use case bisc- um, they're, they're designed to do one or, or very limited set of functions, and they do really well at it, and they're very, very cost-efficient.

Um, and then I think the other trend, um, and, and, you know, people are working on a lot of capital is going to, is, you know, as Felix said, humanoids , right? So these are, um, you know... And the reason why people go with the form factor of a humanoid is, uh, you know, people believe the, the world is, the physical world is designed for humans. Uh, and, and so if you have the human function, um, you have a human form factor, it makes much easier to integrate it as, as part of a life. Uh, without the, without changing how the environment generally is in order to develop, to develop it.

And came along with it is, um, you know, sort of the artificial general intelligence, right? Which meaning the robot is able to learn, um, and, and perform these, these functions by themselves. Uh, you know, I think recently, um, there are multiple technology companies such as Figure AI. They're developing stuff, uh, tech models, they call it the VLA, right? Vision-Language-Action. So these are basically taking the large language model that we're now used to, to the next level. Meaning you're not just given robots, um, uh, verbal, uh, command, uh, but the, a lever, the, the robot is able to see the physical world in the three-dimensional way as we see it. And they're able to interact with it by taking action, by understanding the command, understanding what they're seeing, and then taking action. Right?

So, and then I was thinking the next phase of that development is when robots started working together. I know it's a, it's a scary thought. Right? But, but if you think about what one robot interacting with the, you know, physical space with the human is one thing. But if you have multiple, or, or dare I say army of them interacting with each other and understanding, um, uh, performing a function together, um, like what human would do, right? So for example, um, you know, if, if human, if you and I will go and try to lift a very heavy table, let's say when move around, right? We can communicate that, um, verbally. We can, frankly, we don't even need to communicate that. Verbally we can do it because we can look at each other, say and understand our, our objective is the move of the box. And we can kind of communicate, for example, is not our head, and we understand it's time to lift the, lift the model, right?

So how do you get robots to work together, understand the function they're trying to perform, and, and understand what each other is doing and communicate directly in, uh, uh, in a way and perform, uh, collaboratively. It's sort of is the, is the next, next phase of the development, right? So I think there is a lot more-

Alex Miller (

Seems the future there.

Shenwei Zhu

... Right? There is a lot more, the technology, needs to go to get there. Uh, but I do know there are companies and, and multiple companies including Pudu and, and others are, you know, doing a lot, uh, very innovative, very exciting things related to, to these, um, in these areas.

Alex Miller
16.10

And maybe Felix, I could just pick you up on one of those points, um, particularly that relationship between humans and humanoid robotics in the service industry. Uh, we heard there Shenwei talk about initially it's gonna be about an additional humanoid working alongside other people. But do you see them becoming a lot more common? Uh, and, and actually, you know, we as people are going to have to interact differently with, uh, with humanoid robotics.

Felix Zhang
16.39

I think in the future, working to see humanoid robots working with human, um, more and more common, um, uh, uh, and uh, along with that, I think as, as, they're going to, uh, more kinds of robots working with people. Uh, for... And so it's not only humanoid robots, but, but there are, uh, specific robots which, which focusing on, uh, uh, one, one task and there are semi-humanoid robots, uh, which, which means there are, uh, well-based conc- combines with, uh, robotic arm. Uh, basically I think there are all kinds of robots working with people.

Alex Miller (
17.25

I guess also I wanted to kind of touch upon your thoughts, because I know you're involved as a company, with different governments, with different, uh, initiatives to encourage collaboration. Because it, it, there's a lot of kind of collaboration to make this work. Um, can you just share some of the things that you're doing with governments or different initiatives that help grow this space more broadly?

Felix Zhang
17.50

We have been in this business in, in a lot of countries, uh, including U.S.Germany, uh, UK, France, uh, Italy, Spain, uh, Japan, Korea, uh, Australia, uh, China, uh, ju- just a lot of countries. We have business in, in those countries. Uh, doesn't mean we are working directly with different government, but us, uh, because we, we didn't s- sell any robots to government directly, but, we really, havecompliance, with every government's, uh, regulation. Yeah.

Alex Miller
18.23

There's a lot of regulatory different trends, I'm sure. Sorry, Shenwei, you wanted to, to jump in there?

Shenwei Zhu
18.28

Yeah, I do think with, with the development of and, and accelerated deployment adoption in robotics, I do think there, there will be more, government policy, uh, that needs to develop as alongside of it as well, right? So, and, and not obviously not just sort of adapting the industrial standards and safety standards to, to the new technology and the new, uh, reality of, uh, you know, more and more automation. Uh, and clearly it will. Although I think most of the,robotics, I think in the near future or in the near to medium future will be, uh, not necessarily fully replaced

human workers, workers but really kind of working alongside of human. Right? To, as a complementary supplement to human, uh, labour. But at some point it will have impact on the labour force.

Um, so I do think there will be needing in the longer term, uh, the need to be development arou, around on government policies to address sort of how do we really, leverage the technology to improve, um, sort of the social, uh, safety net? Right? To, to really making sure that, um, you know, people who are potentially being impacted by these technologies, uh, will have to receive some sort of level of, uh, uh, you know, universal income or compensation. So I do think there'll-

Alex Miller

It'll be more chance.

Shenwei Zhu

... lot more of that related to a,I would think multiple layers in the government, from government rights, i- industrial policy, it is, uh, adapting the standard, the safety industrial standards to the new reality of automation. And then in the longer term, I do think governments need to really think about, uh, and have policy around how do we making sure like, you know, the, the, the deployment of robots, particularly around humanoids when they're designed to, to particularly working alongside of human and, and not just performing, you know, particular function, but generally speaking, able to learn, uh, a task very quickly and perform these tasks. Uh, they will have an impact on the, the labour force. So how do government respond to these changes is something that we, uh, uh, we have to, we have to see how it develops over the next decade.

Alex Miller
20.48

And that's a, that's a great point, Shenwei, in terms of industrial policy needing to explicitly be cognizant of and integrate the emergence of humanoid and robotic technology going forward. And clearly there's a political aspect to that as well. Maybe Felix, I could just bring back to you, you know, not many companies, you know, emerge and successfully thrive as yours have over 10 years. Uh, and I'm sure it's still early in your, your growth path. What, what advice would you give to, to those listening to this podcast who are perhaps a- aspiring entrepreneurs who are looking to start their own robotic business or, or indeed a br-, a broader startup? What experience would you share with them in terms of how to, to, to, to be successful?

Felix Zhang (
21.30

Okay. I, I think, uh, first is, robotics company really needed to focus on, uh, technology and product. Uh, th- b- that, that is the fundamental of a robotics company. And I, I think the, the third, the second is, uh, uh, robotics company has to work with, with passion and, uh, long t-, long t- term, terms. Uh, because+ robots is, is really hard. there are a lot of, uh, tonnes of technology needed to develop, uh, and, and more, uh, more help for robots need to be, uh, invented. Uh, so, uh, yeah, I, I think passion and the long, long, long-term things is, are very important. Uh, I think the third s- suggestion would be, uh, work with your customers because, uh, I think there are a lot of technology companies, uh, like to say, "Hey, w- we have, uh, really, uh, emerging ad- advanced technology." Uh, s- s- s- s- but, but, but sometimes customers just, uh, uh, j- just, just don't care because, uh, PMF is, is really important.

Uh, so I think every technology company has to l- listen carefully to your customer, uh, work with your customer, uh, or co-deve- develop robots with your customer. Uh, that is really, uh, i- important. Uh, I think the f-, the, the first suggestion would be, uh, uh, be open, be open up and, uh, and, and, and, uh, and global, uh, b- b- because, uh, I, I, I think d- different countries, uh, maybe have different, uh, customer needs, but, but generally the, the, the

customer needs are similar. So, so, uh, uh, I, I think almost every company needs to be, be, uh, to, uh, become a global company.

Alex Miller

23.30

So the technology arms race, make sure you understand the technology.

Felix Zhang

(laughs).

Alex Miller

To have the passion and the, and the vision for the product itself, and to-

Felix Zhang

Yeah.

Alex Miller

... to never lose sight of the importance of that. Collaborating with customers.

Felix Zhang

Mm. Yeah.

Alex Miller

Co-creating with customers.

Felix Zhang

Yes.

Alex Miller

So you're kind of, you know, you're h-, you're, you're completely in sync there. And then really thinking globally in nature.

Felix Zhang

Yeah, yeah.

Alex Miller

Uh, given th- the nature of this business. That, that, that's fascinating.

Shenwei Zhu

23.54

It's really interesting, it's really interesting you mentioned the customers 'cause at the, um, at our, uh, robots conference, I hosted a CEO panel that, um, had the Locus Robotics, uh, CEO and the GreyOrange, um, uh, CEO in the panel. And when we talked about, asked them, you know, how do they scale their business, what are sort of like the number one key takeaway, both of them and looks like you share the same, um, uh, same comment is really around serving the customers and, and developing the solution to solve a customer problem. And, and the sales motion is very much focused on delivering the ROI for the customers.

And it' interesting. I'm not an entrepreneur, but I, I, it's really intriguing to, to hear all of, y- you know, you guys, all three of you are very successful, uh, companies in robotics, uh, in scaling up robotics really kind of mentioned, uh, around serving the customer's needs, uh, focused on customer, using the technology to solve a customer problem versus the other way, which is, "Oh, I have a technology and how do I find a customer to use my technology, right?"

It's, it's really sort of the customer-first approach, which is leading you guys to, uh, to be able to deploy robotics at scale, which I think that's a really, you know, maybe it's a small thing, but I really think that's a very, very important takeaway, uh, in all the, you know, including Pudu and other robotics companies I've seen, it's, it's really a key point in, in achieving success.

25.26

Alex Miller

That's a great point, Shenwei, and, and, and one that's clearly s- and differentiates the, the global leaders in this space as well. Um, Felix, uh, Shenwei, we, we've covered a lot of ground here and it's been fascinating to get a glimpse into this emerging space. Uh, there is the, the Citi report, uh, on robotics, which people are more than welcome to, to take a look at. But thank you both very much for, for sharing your time. It's, it's really been a fa- fascinating discussion. Thank you.

Felix Zhang

Uh, thank you, Alex.

Shenwei Zhu

Thank you, Alex.

25.54

Disclaimer