**CRAIG:** Hi, I'm Craig Smith and this is Eye on AI. I apologize for using an AI synthesized version of my voice, but I'm finding it quite appropriate for a podcast on artificial intelligence. This week, I was at Amazon's re MARS conference in Las Vegas, which focused heavily on aerospace and robotics. I had the opportunity to talk to Ken Washington, who leads the company's consumer robotics team. Yes, Amazon has entered the thinly populated consumer robotics space with a compact wheeled robot called Astro. Ken talked about Astro's evolution, it's popular and possible use cases and what might be in store in the future. I found it facinating because we all dream of having robots in the home. Astro is a modest step, but an interesting one.

**CRAIG:** Before we begin, I want to mention our sponsor, Clear ML, a collaborative open source MLOps solution. They offer an end-to-end system for building and deploying machine-learning models. Check them out at clear.ml. Tell them Eye on AI sent you.

**CRAIG:** Meanwhile, I hope you find the conversation with Ken as fascinating as I did.

**CRAIG:** Ken I'm delighted to talk to you . I'm interested in consumer robotics. If you could describe, first of all the product that you're working on and whether there are other consumer robotic products in the pipeline. And then I have some questions about robots in the home, generally.

**KEN:** Sure. Our project is called Astro and it's a consumer home robot. It's Amazon's first consumer robot. We've been doing robotics for years at Amazon in our fulfillment centers. But to do a robot in the home is very different. It required us to solve many hard problems because in the home you've got a much wider variety of types of spaces. You have to coexist with humans. You have to deal with clutter. The robot has to be designed in a way that is not too expensive, and we wanted it to be a relatively compact form factor so that it would be, welcomed into people's homes.

**KEN:** And then you have to address security and safety and privacy issues. We solved all of those problems to make Astro a reality and to launch that product late last year. And so now we're selling Astro to consumers and we're receiving great feedback. It's just the beginning. This is our first consumer robot. It's not gonna be our last I can't talk about specifics on our roadmap, but we are committed to this space and we're gonna be building robots and making Astro better and doing all kinds of things with robotics in the home for years to come.

**CRAIG:** Astro is a wheeled robot with a touch screen. Is there any talk of doing a legged robot?

**KEN:** We're not gonna rule out anything. At Amazon, we do what we call working backwards. And as we work backwards from what customers want and need and what we observe then we design what will be successful in the market.

**KEN:** Stay tuned and we'll see what the customers tell us we need to build next.

**CRAIG:** When was it launched and how large is the customer base at this point?

**KEN:** It was launched late last year and we continue to ship new devices to people on a regular basis.

**KEN:** It's what we call a day one edition product. It's a delivery method that we use for some of our most ambitious products. And it's a way to get those products into our customer's hands quickly and early, so that we can learn and make the products better over time.

**KEN:** So it's in limited quantities. We don't break out specific numbers. But I can tell you that we've got enough products in customer's hands that we're beginning to learn.

**CRAIG:** I understand you can't talk about the install base, but is it dozens, hundreds, thousands? Can you give me a sense of scale at all?

**KEN:** It's a limited edition product it's not millions like echo devices .

**CRAIG:** And are you collecting data? For example, industrial robots send data back to a central server so the AI brain, so to speak, learns from the experience of all of the networked robots. Do you do that? And is Astro a learning robot. Does it have a learning function or is the deep learning in the initial product, but once it's shipped it's static.

**KEN:** It's a bit of a hybrid.

**KEN:** So we don't do the kind of learning that you described that we use in our fulfillment centers, because it's for a home. And so the intelligence that's in Astro is the intelligence that we teach it in the development in our own laboratories, because Astro is connected to the internet and it's an intelligent device that has onboard processing and memory and AI models, we can update those models based on improvements that we make and development that we do in our own development labs. We don't collect data from our customers in their homes to improve Astro for other people. So once it has the intelligence on the device, the mobility platform on Astro is all processed locally.

**KEN:** we do that for privacy and security .

**CRAIG:** Process locally, but there's no learning locally.

**KEN:** There's no local learning.

**KEN:** We have a regular cadence of updating Astro over the air so that it improves over time.

**KEN:** And we develop those updates based on what our customers tell us they want and need, or things that we learned that aren't working as well as we wanted . So it will continue to get better.

**KEN:** One of the things we recently did was we updated Astro to include more games and improved some of the games that were introduced at launch. It's a companion and as a companion, you want it to do new things.

**KEN:** And you want it to surprise and delight and it can do that if we update it and provide additional features.

**CRAIG:** Actually, that's something I wanted to ask you about. There's you know, this engineer at Google claiming that one of Google's large language models is sentient. And I think everybody who's involved in AI is more than skeptical about the sentience, but humans invest technology,

**CRAIG:** they invest animals with human characteristics or personalities. They imagine that this animal is interacting with them on a human level with emotion and that sort of thing. Sony had this robotic dog AIBO that was a household pet, and people became extremely attached to it in the way someone would with a live dog to the point that when the robot was discontinued people held funerals and lot of elderly people in particular were really heartbroken. With Astro, do you see that? Even if it's got limited capabilities that people invest it with personality and even sentience?

**KEN:** We're quite direct about that. We designed Astro intentionally to have personality. In fact, if you look at Astro one of the first things you'll notice about it is it has eyes on the screen and it has eyes because we want it to have personality and the eyes give it ability to express things, it can express like surprise and delight or sadness . eyes have a way of projecting expression. And so that was quite intentional and we've also designed Astro so that it can combine those eye expressions with its motion.

**KEN:** And we implemented this engine that we call a choreo engine that allows Astro to choreograph motion with its eyes. We even invented a game called animal charades. Astro will act out a number of animals. And you have to guess what animal it's acting as. So the whole idea of a personality is quite intentional because we want Astro to give you that companionship.

**KEN:** Now there's a very serious angle to this as well, because we are seeing that people use Astro to provide companionship for a loved one, someone who needs additional care. If they can't be with that person all the time, they have peace of mind knowing that Astro is there. And they can drop in and see and interact and talk with their loved one from a distance, even if they're a thousand miles away. Let me share a story with you.

**KEN:** One of our customers told us that they had Astro set up as part of the Alexa together, cuz we have that feature built into Astro. It works as an Alexa together device where it will provide 24 seven interaction with a person. It would notify them every day the first time that their father interacted with Astro.

**KEN:** And one day that notification didn't happen. So they thought something must be wrong. So they used the Astro app to remotely drop in. They drove Astro around, looking for their father. And they found their father. He had fallen out of his wheelchair. And so they called 9 1 1 and dispatched the paramedics and it may have ended up saving his life.

**KEN:** So this is a very serious feature of Astro to provide companionship, not just entertainment companionship, but safety companionship.

**CRAIG:** I have to say I'm a skeptic of things like Astro. Fast Company had a very negative review of Astro about how it's more trouble basically than it's worth.

**CRAIG:** But what interests me about it is providing companionship to people who are alone. Together with this idea of the Sony dog robot and how attached people got to it, I can see that could provide an important function for people who are home bound and alone. Is there any child development uses that you've worked on?

**KEN:** We are already receiving feedback from our customers that kids love it. And we're reacting to that feedback and it's one of our priorities on our roadmap is to improve Astro's ability to interact with kids. Right now we, we do have the ability for Astro to be in kid mode. And we're gonna only improve that because we're hearing from our customers that they want to have Astro be a platform that they can use to provide entertainment and education for their kids.

**KEN:** So it's something that we're gonna make better over time with Astro. To your earlier point about companionship for loved ones that you have to leave behind occasionally and for families that just want to have a companion. I would say that's a very individual thing. Some people want it and need it and react positively to it, others don't. And so I think you have to experience it for yourself. We are hearing very clearly without any ambiguity that we do have a segment of our customer base that really wants to use Astro in that manner. And in fact, when we gave Astro to a number of beta testers and they had it in their family for a number of weeks and we had to bring it back because they were beta testers.

**KEN:** They told us they really didn't wanna see it go because they have become part of their family.

**CRAIG:** And as you're saying that it occurs to me, it's unfair to have a journalist do a review who's gonna be naturally skeptical to begin with and isn't having it in the home because he wants it.

**KEN:** It depends on the nature of your family. And we'll just continue to build on what we have. So we're quite excited about the future because of that.

**KEN:** Some people really love the home monitoring feature, where they can see what's going on in their home when they're not at home. It can also be more proactive if it sees something or hears like breaking glass or a smoke alarm, it can actually send you notifications or take photos of people, if it sees someone in your home that it doesn't recognize because it has facial recognition.

**KEN:** In fact, I used this feature when I was on vacation. I have a cat sitter that comes in my home every day to feed my cat and leave. And one day, my smart home told me that the front door was left open. I thought the cat sitter didn't close the door. So I pulled out my Astro app and navigated my Astro to the front door and took a look and sure enough, the door was closed and locked. It was just that my sensor had run out of batteries.

**KEN:** We hear dozens of stories like that all the time.

**CRAIG:** Yeah. On the elder care idea I've been talking to a researcher Fei-Fei Lee at Stanford. Who's working on ambient intelligence, which is the idea of having sensors throughout the room or the home that then can feed into a central AI engine that can spot patterns or anomalies that are important, particularly for elder care. has there been any talk of using Astro in say a nursing home setting or a setting where people have restricted mobility.

**KEN:** So it's very early in our journey for Astro. One of the things that's happening with Astro now released to the public and available is we're receiving calls of interest from lots of people saying, Hey, could Astro be used in this setting?

**KEN:** Could Astro be used in that setting? And so the example you just gave, could it be used in a nursing home or in a assisted care facility or even in a. For assisted care with a service we're hearing questions being asked about those kinds of use cases. In its current form. It's not designed for that, but it's not hard to imagine how we might evolve Astro or improve it, or provide some service on top of its existing form to enable it to work in that kind of environment.

**KEN:** So it's something we're thinking about. As I said earlier we work backwards at Amazon from what customers tell us they want. And what we imagine will be valuable. We ask ourselves two things when we start a new product or a new service is it meaningfully different from what's available and two, would it provide value to customers and would it be useful?

**KEN:** And in the cases that we're hearing from customers who are asking, could Astro be used in this setting? Could I put it in my business? Could I put it in a school? Could I put it in my office? These are questions that we're asking ourselves, these working backwards questions. And so we'll see how that plays out over time, but it's something we're paying attention to.

**KEN:** I wanna go back to something else you said from the discussions you've been having with professor Fei-Fei Li. This whole idea of ambient intelligence, no company has more devices in homes that are smart devices than Amazon . And so it's very natural for us to find a way to stitch together these smart devices in your home, including an Astro device.

**KEN:** To give you a sense of collective intelligence or ambient intelligence about the environment. So we see that as a really promising future role for Astro as a node in an Amazon ambient intelligence platform or ecosystem. So it's something also we're very seriously thinking about, and we're very excited about. Customers want Astro and all the Alexa devices in their home and their ring cameras to all kind of work together to give a sense of what's going on in their home. And how can they all inform their life in a more positive way?

**CRAIG:** Astro right now it's small.

**KEN:** it's small. a relatively small device. It's about 20 pounds, but it's powerful. It has lots of really capable cameras and, eight microphones on it and lots of AI processing modules and a Periscope that goes up to 42 inches. So it's small, but it packs a bunch.

**CRAIG:** Yeah. Is there talk about scaling it up for some of these use cases, for example, in a assisted living facility. Where it, has a higher vantage point and maybe a more humanlike appearance to people.

**KEN:** It's too early to speculate on what our future robot might look like for these kind of applications, but, we're not taking anything off the table yet.

**KEN:** We'll work backwards from what our customers tell us they want and what the requirements are for providing robotics in those kind of settings. But it's too early to speculate on what it would look like.

**CRAIG:** What are some of the challenges, or what would you say is the greatest challenge that you face?

**CRAIG:** Is it the mobility? Not every home has open floor space without stuff in the way. Is it the interaction or the visibility, the camera or what are the things that you're focused on?

**KEN:** I wouldn't rank any of them, but I'll just summarize a few of the really hard problems that we had to solve.

**KEN:** The first one I'll talk about is intelligent mobility. Our mobility platform had to be really invented because you couldn't take an off the shelf, simultaneous localization and mapping algorithm, like a slam algorithm. There are many out there. You couldn't just take it and drop it into Astro because lighting conditions in homes are different. Every home has a different layout. People walk around homes, you have clutter on the floor, you've got staircases you need to make sure, you don't fall down. So we had to design our own visual slam algorithms that work with low cost sensors that work in different lighting conditions , and then we have to design that to lay alongside a separate security system that prevented Astro from bumping into things and from falling downstairs or from going in places where you ask it not to go. So we allow people to define out of bound zones. So for Astro to have what we call intelligent mobility, that was a very hard problem. We continue to evolve and make that better as we address feedback from customers using Astro in a variety of different environments.

**KEN:** But we had to test that in literally thousands of different configurations in homes before we launched and we continue to improve it. Other hard problems we had to solve were the ability to have intelligent interaction with people.

**KEN:** So how do you actually visualize a face and then know what that face is, and be able to process that on the device, because that was important to us to process visual recognition on the device for privacy reasons. So we had to invent a way to quickly see a person and then know who that is. And then represent that in a way that could be stored on device securely and encrypted.

**KEN:** So many hard problems had to be solved and then developing the engine for Astro to have personality. Doing the industrial design for Astro to have the right kind of appearance to be approachable, but still endearing. All of those things were part of the Astro invention.

**CRAIG:** Is this like the iPhone that this is Astro one and every two or three years, there'll be a new Astro?

**KEN:** I'm not going to give you specifics about our roadmap, but I will tell you that I have a lot of conviction and commitment to this program.

**KEN:** I left my job in the Midwest and moved to California because I believed in what Amazon was doing. And I believed that it was gonna be big and important and make a difference to society and be really an exciting thing. look this segment didn't exist. people have been trying to do consumer robots for a long time and no one's been able to pull it off.

**KEN:** I saw that Amazon was moving in the direction of pulling it off, when I saw that, I immediately said I wanted to be part of it. I was the chief technology officer at Ford. And so I wouldn't have done that if I didn't think Astro was gonna be a really important product, that's gonna define a new category.

**CRAIG:** Was there much cross pollination with Amazon robotics team, the industrial robots, which have a very sophisticated navigation platform.

**KEN:** Yeah, so we interact quite often with the Amazon robotics team and also with the robotics AI team. We collaborate with them. We share insight and science techniques, but the nature of the problem is quite different. And so there's not a lot of direct code sharing.

**KEN:** We're very vertically integrated at Amazon. So our product is architected for our use case, but we do talk to the Amazon robotics team and we share knowledge about science problems and maybe even some cases we'll share insight about how we're solving problems. So we know each other, when we talk to each other, we learn from each other.

**KEN:** But we each have our own techniques and architectures and priorities associated with our customers.

**CRAIG:** That's it for this week's episode. I want to thank Ken for his time. I also want to thank Clear ML for their support. Take a look at what they have to offer at clear dot ml.

**CRAIG:** And remember, the singularity may not be near, but AI is about to change your world. So, pay attention.