



Jake 00:16

Thank you, Jules for coming on the podcast and taking the time to join me today. I really appreciate it. You are the founder and CEO of Oh toy and also the founder of render network decentralized GPU rendering platform, you've got a super interesting perspective and sort of vision for the future that you've been building towards for 20 plus years now, and so very much looking forward to the conversation, and it's been a blast prepping for it. Before we dive into, you know, the more particular details, I think the best place to start would be to understand your story a little bit for those who don't know, you who that who are not familiar with renderer, or Oh, toy or anything like that. And if you could start sort of as early as you're willing to, to kind of tell the origin story a little bit some of the decisions you've made to get to where you are today.

01:02

Absolutely. Well, Jake, thank you for having me. It's a pleasure. Well, my origin story. You know, it's yeah, my background is in computer graphics. You know, I and I know that covers a lot, right. I started with a deep interest in video games, as well as as filmmaking and linear content. And I think, you know, there's one part of my story I walked into the Sandman for pure when I was a child. And there was one video game that stood out among the rest, it was almost like a shining light a spotlight on this versus everything else. This was in the era when there was Pac Man, and you know, spectators nothing crazy with graphics. And here's Dragon's Lair, it was a Disney quality movie. And there was a joystick and I was like, What am I looking at, like, this thing looks like a film, but you can interact with it, you can play with it. And of course, you know, it was basically a movie where you could skip around to the different parts, but it was designed in a way that gives you this interactivity. And it changed me It changed my childhood, mind and brain in a really fundamental way, and I wanted to be I knew whatever I was gonna do in life was somehow going to be related to this, this concept of being able to experience things and have computers get to the point where the graphics are so real, that they look like reality, but still have the agency as as a viewer, or as a video game player or somebody they interact with them to, to have those experiences that to me felt like the future of storytelling, the future of art. And weirdly enough, a few years



later, you know, an episode of Star Trek, I love Star Trek since I was three years old, I, you know, old school that way. But there's the first episode of structure the next generation in 87. And he walked into the room on the Starship Enterprise called the holodeck. In that room, everything that I had been thinking about for those years, as a kid had was presented there. It was a room where you could render anything, you didn't have to wear a pair of glasses, you could interact with it, there was a bit of AI that would make the you know, you want to have a Sherlock Holmes story. And, you know, Victorian England, it would do all that. And that was like, Oh, this was an even better version of Hi, I want to see and experience these things. And holodeck was, you know, Star Trek. I mean, everything is explained pretty technically, it's a whole, you know, it's just a room with turn off the holodeck. And you'd see it's just a bunch of, you know, tiles and panels. But it could create these holograms and thin air, you could touch them. And I wanted to build tools that would make that content happen. And I figured somebody at some point is going to create the hardware to display it. So you know, you skip ahead to my teenage years, I was, you know, my mother really was intent on going to Harvard University. He thought that was the path to whatever I wanted to do. I did get in, but only because I sent them the source code to all of this work. I even knew I recreated dragons are ahead video compression system 91. And I had already started doing early 3d graphics work. And this isn't back on a Mac two effects. Back in the days when there was almost no memory, there's nothing and and I got in and I didn't want to go to college. I mean, I really wanted to just work in the industry, doing video games, pursuing this sort of technology and see where it led. And within a few years of that, you know, I was still in my early 20s, I put out a tool called 3d groove, which was a plugin that you could use along with Macromedia, which is now part of Adobe, these types of they called Flash before that was called Shockwave. And I allowed you to put 3d games 3d content in a web browser. And from there, like, oh, toys started up, you know, I would say maybe six years after that. So as you're pointing out, it's been about 20 something years. 2002 is when I officially got into it, I calm and you know, two years later, I articles written about it. But my goal with Otoy, and all the things that had led up to that point was to create a tool that would allow you to create beautiful CG graphics on video game hardware, which was something people didn't



think was possible to put that on the cloud and to also have it so that, you know, the cloud meaning GPUs distributed, you know, nodes that would be out there could contribute like, at the time SETI at home, which is a well known, Folding at Home later, right, which is widely distributed compute that work. I wanted that to meet to make it so that was so inexpensive for people to have an idea, create and render these things that have fidelity that would match what you could do in a movie that would cost a fortune. continue to make to make it simple. And also to allow it to be used for both Video games In other words, interactivity and also for linear content, ideally, both. And, you know, bonus points if I can get it to render on the holodeck whenever that's ready. So that was why I started Oh, toy. And 10 years after that, about what lab is about 10 years ago or so I put out, you know, really our first commercial product, which is one of the things we're best known for octane render, it was the first GPU render, it could it could basically do Pixar quality graphics on video game hardware back, you know, 1210 or 12 years ago, when we were starting to do this, it was unheard of. And to this day, it's still, you know, ongoing, great product is the center of the render network, we started with our own renderer, we've added others. You know, since those 10 years have have passed, other people have done GPU renders, we're not the only one. There's, there's a lot of different ways of doing it. And I do think that the world is now at an inflection point, certainly with generative AI art, where the concept of being able to imagine things and having that realize for you, is coming very true. The part where Otoy and the render network, and they're temporary pieces. I mean, they do connect the I started both that they render is a decentralized organization. It's arm's length really promotes at this point. The idea is that we enable these things to happen. And there's a lot of things in the last couple of years that have percolated to the public consciousness, the metaverse, and FTS, those things have valued being able to have digital art that you can make money off of, and your art is seen by everyone. The provenance is they're very important to Metaverse being able to experiencing spatially ultimately in the holodeck, very important, I think the gold rush to sort of exploit some of those things. It's kind of poison the well for how people perceive those things. But they're still very much goals that I have in mind of making those things done, right. And then we have Apple finally putting out a pair of glasses of mixed reality goggles



that are insane. That'll give people a very first taste of probably what a holographic experience will be like. And then beyond that, we've invested in a company called lightfield lab that's built holographic display panels, that without any glasses, it's constructed holodeck was inspired by the very same episode. And those are coming out in the next few years to theme parks to location based entertainment, and probably in the 2030s. It'll be in people's homes. I will pause there. But that's my origin story. Yeah, that's

Jake 07:16

a great overview. And there's plenty of places to plug in. But I'd like to pull on the thread a little bit on these like holographic displays, because people are pretty familiar with, you know, VR has sort of like gone through these hype cycles over the years as technologies do, people are like, this is the next big thing, then next thing, you know it, oh, this is never going to happen. And it keeps going sort of up and down the hype cycle. And now we have, you know, obviously, a few years ago, or several years ago, we had kind of Oculus through the various iterations. Now we've got Apple coming out. But what people I mean, it's not on, it wasn't on my radar, and I don't think it's on nearly as many people's radar is, you talk about these, like hardware enabled holograph situations, can you just kind of describe better, you know, in more detail how that, you know, plays alongside like, obviously, you put on the Apple headset, and you have these things that are sort of visibly in the room, even if they're not there. But you're talking about something where you don't even have to put on a headset at all. And these holograms are sort of visible to the naked eye. What is you know, is that something that you think is underrated relative to AR and VR?

08:22

Yeah, I think it is. But I also think it's so hard that people are I mean, one thing I've been very good at doing over the last, I mean, more than 20 years, right? Is painting a trend that's like five or 10 years out, like GPUs, GPU rendering up rendering the cloud decentraland up rendering AI on GPUs, and, you know, being so early that I just sometimes have to wait or just build towards something. And that's the thing with with like, the displays, I mean, most people haven't seen one. I mean, I invested in a company seen just a small



little prototype that was six interest. But I barely knew how it worked. I knew what my software could do. And I knew that if I had hardware that could, I mean, the way that it works is you can think of it this way, what's the consumer version of what a holographic display will be, there's probably two there'll be really easy for people to understand. The first is, you know, you can go now and get a high sense 100 inch TV or an eight inch TCL. TV for about \$4,000 3000 Right, it's getting down but those are 100 inch TVs for K and that's probably going to be the standard for a lot of people as those prices go down to the hundreds of dollars right and we've seen TVs get larger. Now imagine that you have 100 inch TV that is a window into whatever it is on the other side of the window is no different than looking out of a window right or just looking at interspace that's a clip you still have a frame around that window but it's 100 inches and you can have more of them I mean you can have your if you want to replace your windows with these kinds of TVs with these holographic panels you could but the simplest and most obvious use cases well 3d movies right don't mean glasses. I mean you know the thing that kills 3d TV is and still to be honest makes going to 3d movies pain is going to put out even a pair of polarized glasses between nothing was too much people 3d TV died and it's not because there wasn't content, a lot of move. Things were done in 3d 3d is not tough to generate or create, that's going to all happen again with the Apple headset. But the holographic TV will be able to give you perfect 3d Without any glasses. lickety split, it gets better though, if you actually render for that display, you don't just get left to right out, you just don't get like sort of VR kind of India, you get something very different, you get something that looks absolutely the same as if you're looking at it with your naked eye in reality, and the difference between that and VR is where the light field is, in other words, you can put a telescope through that and you can see it that lighthouse in the distance, even with that 100 inch TV, you can put a magnifying glass on something, and it will work and your eyes will convert you're gonna have depth of field and focus things that people are just not that familiar with. Because even with VR, those effects are just they're not in there, like Magic Leap when they're trying to raise blood or billions of dollars, early, early on when they're trying to build their display. You know, for glasses, right? It was meant to have that light field thing in there, they couldn't pull it off, it's very



tough. But these panels will do that. And 100 inch TV that does is a window into anything is very simple proposition, especially when people want to, you know, experience something that is immersive and a large size. The second light field display, which I think is even more useful, is something that would replace what you have on your desk. In other words, a table like you know, Tony Stark and Iron Man, right things pop off the table, and you can touch them. And he's like the displays do have the ability to see where your fingers are, I mean, even the vision probe has perfect finger tracking and perfect depth estimation. And like the lab is working on something that uses Ultra Sonics to give you a basic sense of touch. So if you push on something, you can feel the feedback, right? That kind of thing where you have something on your table, in addition to having, let's say something in your living room, TV or whatever, or your wall is going to be really useful for work and productivity. And the way that these holograms work is that the you can have something that pops up off the surface up until the edge of that circle. So if you had a really long table, you could have a really tall holographic object. And that's that's one limitation. If you make if you extend that surface to an entire room, if you decided to convert your garage and have all six surfaces in your garage, converted a holographic display panel, you have a holodeck and you literally never see the edge of it. You can have anything you want in there. So the holodeck even though we're supposed to be hundreds of years in the future is literally possible. I mean, it's 10s of millions of dollars, I've asked you know, I'm not one but it's, it's out of my my budget. You know, but I think the practical version of these things is going to be in form factors that we can understand. I mean, it's also going to be in tablets, it's like, you know, like the lab is, I think they're investors, including, you know, Samsung and LG and, and others, right. So it's like those, these will be license, they'll be like OLED displays, or they'll be in everything, including probably future goggles. But the magic is that you will not need to wear anything to experience a lot of the things that are now being created and imagined around, you know, let's call it spatial computing. I mean, apples version is really interesting to me, because you have a full on computer on your head, you have 4k per eye, these are things that have never existed before in a pair of goggles. But you know, they're still, it's still something on your face. And you can't share that with somebody else. Exactly. Right. So



if you have something that's totally organic, I think that's the future of, frankly, windows like things that are you know, if you're in an apartment, you're you know, you can have any wallpaper you want, you can have any window you want, you can have any view you want, you can be anywhere, all of the things that have technology and screens and you know, apples and a lot of work to try to make it so that the glasses don't feel like they're getting in the way of you and the experience. That's why it's mostly a pass through device. That's why you see the eyes on the front. But you don't need any of that with holographic panels. And technically, those things are good, they're 4000 dpi, something crazy. So one meter, you know, 150 is going to be gigapixel something way beyond anything that you did with 4k or VR. Rendering to that is it's tough, but that's why the Reds never use this, you can recreate anything you want to imagine every it just costs a little more. And we're already seeing that creating VR content, creating content for the industry sphere on the render network. I mean, these are, you know, multiples over a 4k video. But that's that's where things are heading. And as rendered ever becomes more efficient. It's going to probably time itself in the way where these, you know, these light field displays, these holographic panels will probably end up shipping to users and the time where it's going to cost about the same to render for that as it would for the pair of VR glasses. So I'll pause there. Yeah, I've

Jake 14:13

seen you know, what you guys are capable of with Oh toy and you know, these sort of next generation graphics. It's just pretty incredible quality video, and that's, you know, not even getting into what you're talking about now. And obviously want to get into the vendor network and the importance of sort of better, making more efficient this market for GPUs, essentially, and utilizing underutilized GPU assets around the world. But before we get there, I want to sort of tee up how you got here in the first place. And we went through the origin story, but and you know, you talked about deferring your Harvard acceptance never ended up going there. Everything like that. There was one interesting story that I read up on, which was Ari Emanuel. See No, of William Morris Endeavor, I think sort of discovered you fairly early on. And I understand like he offered you a million dollars within like a month of meeting you, you were living at home at the



time and you know, your mom's house and you're like, I can't take the money. I'm working on something that's like, way more valuable than that. And, you know, this would be a distraction. And like, how did you have, you know, most people, like you get offered a million bucks, like you, you know, you take the money and you go and build something or whatever you've been, it seems like laser focus, like, you know, another sort of parallel, just sort of observation is that you've been, you know, we casually mentioned at the top, you've been working on this for, I think, oh toy you said 21 years ago, in general and space for like, 25 plus years. Most people don't stick with something that long beginning when they're like a teenager. So yeah, what's like, sort of, I mean, obviously, there's the Star Trek inspiration and stuff like that. But what has sort of enabled this obsession to remain ongoing, and has given you, you know, you mentioned also like, you sort of have been early to a lot of things where it's like, you know, there's only the wine out question. And rarely, you know, if you're too late, it's sort of obvious. If the time is right, it's not always obvious. And if you're early, it's sort of blurs the line between being being at the right time. And being early, it's kind of hard to tell, especially if you're very forward thinking, so what has sort of kept you on this on this track for you know, 20 to 25 years?

16:26

Well, obviously, I have a deep passion for all of this. I mean, that's, you know, and that started from childhood. So that's always been part of who I am. It's not hard for me to get up in the morning, or sometimes not sleep at all, and sometimes has to be up for a week and just work on stuff. And so when Ra Ra is like family, and you know, he's, it's been about 19 years since he showed up maybe more than 18 years since you showed up at my mom's house that night, Friday night and Valley. And so I was doing and he did offer a million dollars. And I did main thing was, I was like, this would be great at some point in the future. But right now, I have two more years of coding, just me alone, drinking, you know, Code Red, which is, I couldn't see, there's still some trickiness to your narrative for the day, but, and you know, and I said, it's gonna take me like at least 18 months before I have pieces, like Cloud rendering, Ray tracing on GPUs, I was in the middle of all these things. And it was funny because at the time, he'd heard about it, because the New York Times



was reading an article on Oh, Toyota within the exist, it was me in my mom's house. But they still wrote the article. And it was after that me. And so you can see the prototype pieces that were there. But I, you know, I basically, I won't stop until I'm until there's a holodeck and until the world is as right as it can be. But the things that I'm doing, I have things I want to tell sort of I use my own products like I use the render network and I use octane and and try I love Star Trek. And yes, now we're working on Star Trek stuff. I should also mention my best friend's dad created Star Trek, I grew up in Gene Roddenberry's house with them. And, you know, we, it's part of the DNA of everything I'm doing. But there's part of it is passion. There's also a part of it that, you know, I see a lot of things that I've, you know, when I started 20 years ago, toy proper as like, there's a lot of missing pieces that people are just missing, like, there should be cheap GPU rendering, and ray tracing should be a thing. And, you know, cloud streaming, right, this before cloud gaming was even known, I was one of the first even show that working before OnLive, retire does others, you know, I was like, These things should exist. And I don't, and I'm a one man band. I mean, this is before I had anyone really working form you're with me. And back in those early 2000s. I built all that I wrote the Codex, I read all of that, and I made it all work. And that's in 2006. When I really came back, it wasn't to give me money, it was to help me build a business, you know, do you help me get proper investors? And what what sort of gave me that focus even say, No, or even Wait, was it I, but in 2002, I'd already been doing this for about a decade, you know, it's like I was I had, you know, and had other businesses that didn't quite work, all versions of this, but in some ways, I just felt like I needed to build as probably years of this on my own, prove everything out and also run the company and be the CEO effectively, because I never wasn't in previous things. I just wanted to code and build things, and not necessarily own how it how it went out. And that was that was a mistake. On the other hand, when when I did get things working, and I did invest years and years of just pure focus. In the early 2000s, things started to get really interesting. And I had enough of those pieces working that then it made sense, to get investors to get a larger team to build things around it. And I still have that focus on some people, even with a render network. You know, I'm very flexible with how things go. But I'm also perfectly happy to wait I mean, so the patents have taken out



or I mean, they're about to expire, they're 20 years old, but they there's things that that take sometimes a decade to play out, and I can't help it. When when there's a case where I see something so clearly that I just know that it's just a matter of time. And it's something I cared about, you know, not just on the financial reward aspect of it. It's mostly just because I think technology's going to be amazing and life changing. And computer graphics are part of that. I mean, even as as crazy as AI is there's still that aspect of AI that is visual that is part of a medium of creation that I think is the most interesting part of it. And I, you know, I think that my devotion to the end is to the end goal is something that is not, it's not like super rare, but it's not, you know, everywhere either a lot of people just, they see an opportunity like NF T's and meta verses, and I'm like, you know, those are things I care deeply about digital goods are a huge fundamental part of why the render networking system better versus well. And I'm sad that people were trying to build an 18 month plan around something like that. I mean, I can understand the opportunity for that. But I, you know, there is still years ahead of that, you know, in terms of making that work, I had the pleasure of actually getting to know Neil Stevenson, and we talked about the universal line, and he agrees with me like this, you need to take your time do it right. And doing it right, I think this is a huge reward. I mean, it does end up with success. I mean, I've always been a very successful company. And it took a long time to have a product like Octane that would generate the kind of revenues and it's doing now, and that helped us get rendered going and surrender to, you know, when we launched, it wasn't that big of a deal people didn't think about or know about it that much. But now it's become over the top 50, you know, coin or token or thing on the on the on chain. And I perceive that, you know, waiting doing this right and long term is going to, it's going to provide a lot of things but to other people as well, not just selfishly the render network, or even Oh toy, but to any one that's participating in this ecosystem. And some of those secondary effects are like people, you know, who've been using our tools for years. Obviously, his talent is his talent. But it was amazing, you know, got the cover of Time Magazine, and he graciously put our software octane in the cover. I want to see everyone have that kind of opportunity. That's why the NF T space was so interesting to me is that people as artists can can make money in a living with that. And



that's, that's the future, even a post AI future. Something like that is going to be very important for creativity is rewarded. Good creativity. But I will stop there. That's that's a lot to your question. So

Jake 21:51

yeah, no, that's great. And I think, you know, you mentioned discussing the metaverse with Neil Stevenson, obviously, that it's a massive sort of concept. And everyone has like their own different take my personal leaning, like, you know, I don't really have like some sophisticated view. And I would love to hear yours. But my one thing that I sort of think about is that it's going to be sort of like a much more gradual transition that like we are not fully not in the metaverse today, like look at you know, I'm a friggin avatar and I'm talking to you guys through zoom. Like this is not us sitting in a room together. And it's just going to be you know, you're no longer doing this on your laptop. You're doing this through your goggles and maybe, you know, I don't know if you saw like the LEX Friedman duck interview?

22:37

Avatar Codex, your critic avatars? Yeah, yeah, exactly.

Jake 22:39

That was Oh, that's interesting. Yeah, there's a lot of overlap. I guess that technology that Facebook used or meta use to make that happen is very related to your guys. What is it light stage? Like

22:50

stage? Oh, toy? Right. Yeah. I mean, we've we've been we've picked up some highlights he can to a lot of vendors, you know, and that's no secret. I used to work with John Carmack when they were starting. Well, and sorry. I mean, when Oculus was bought by Facebook, we did a ton of stuff. And I loved it. I loved those years. And you know, he's subsequently moved on to doing AI stuff. And I love him. He's a genius. But we were doing stuff. And I remember that we were, you know, flights, he has been a resource for people. I mean, even you know, it is Sunday, if you're gonna do faces of any kind, anything, whether it's AI or rendering, having that ground truth is really



helpful. And certainly for machine learning, obviously, I think the sag AFTRA trades just about the end, hopefully. But you know, the big sticking point was digital doubles, scans, and people, right? We've been in that business longer than I've had, I think, oh, toy, you know, toy officially, like 2009 as an incorporated entity. I mean, I'd started, you know, the name and stuff was was was here before, but But you know, like, CH I initially got my first investment around that in 2008. And we've been every Marvel movie, every DC movie, every actor has been through our offices to get scanned. And it's funny, because I think that AI is, I mean, the interesting parts, of course, your large language Bibles are very important. I mean, that's the thought vectors of the human genome or human consciousness, right isn't. But then you have the visualization of people. I mean, if you, you know, you hear catch up to and you talk to it, I think just added to talking, you know, voice and voice out recently, it's pretty compelling. But you know, when you're when you're generating digital faces, both as a creator and both is AI trying to sort of match what you're thinking, you know, it's it's tough, it's tough. Deep fakes are like, you know, the simple the foam on the on the ocean, right? I mean, there's such a depth what you're doing with with human expression experience, and this stuff with critic, avatars is important because again, if you're going to transmit something, your expression your face, holographically, you still need to scan it in the display is only part of that. So what they're doing with fabric avatars is really helpful, obviously, but you know, Apple's got something similar persona, in the in the vision Pro, but you know, there is, to be honest, the way that I looked at the local displays, and I've talked about this, we tried Karafun, the creator of that company. It's a two way mirror, it's like it records holographically and transmits holographic view. So if you're looking through it, you're seeing a hologram that's being recorded. There's a hologram on the other side. And, you know, there's also the fact that AI is extremely good at taking a very few set of data points and figuring out the missing pieces. And that's when you kind of need to make this work at a much more efficient level, whether you're displaying holograms reporting them, or even rendering them.

Jake 25:16

Yeah, I mean, so I think we got on to that by talking about like the, you know, the ZOC and Lex interview before that I was getting at the



metaverse and the gradual transition, and you seem to sort of agree with that, do you have, you know, despite being the, you know, being a being early to a lot of things, and I read, someone described you as like, sort of the pioneer of a lot of technologies that have yet to be named, basically, like coming up with these things that don't quite have, you know, basically don't have names yet, and then eventually sort of figure out what to call them. But do you have a sense of like, where we are now, in that transition? And, you know, as hard as it is to tell the future, just what that vision in broad strokes looks like to you and what you mean, like when you say Metaverse,

26:00

yep. Well, I think that to your point, the metaverse is it's like saying internet, not even the web, right? Just internet. It's a protocol layer in the sense that I mean, we have to figure out what made the internet interesting. And the web was just part of it is we had formats for video. And we had formats for documents when the web was introduced. And then we had social media, which was layer on top of those things. We need to work we need organizing formats for the metaverse and some of those obvious ones were 3d models, right, you know, which, you know, to one of the projects that we started with. Brian Berry, my friend was like archiving all those structures, 800 hours and 60 years, visually, including the production versions being able to walk on the ships, right. So the way that those 3d models for the Starship Enterprise that we're building life size, one to one digital doubles, which if you look at in video Omniverse, like digital doubles in the real world is one aspect of how they consider the metaverse write experiences that you can go into and experience in, you know, like a theme park is another aspect of the metaverse. But what are the 3d models for that? And I look at it as there is no one format. It's a platonic version of like, we know what their ships kind of supposed to be. We know the size of it. We've seen it film, but the depth of it all the way down to the atomic structure of the metals used in the beams or whatever it is. It's It's infinite in the sense. And so I think the the idea of the metaverse is you start with the idea of the thing, right? You know, the Ship of Theseus component of the Starship Enterprise, literally, it's even a theme in the in the show. And, you know, it's just me, this stole of it, the spirit of it, the form of it, and then you know, how it's realized is something



that's on demand. So, you know, if you look at the work we started two years ago, we're like, this is this stretch of enterprise here, the blueprints, it's going to evolve. I mean, 100 years from now, that asset will still exist, it's on chain, like they actually are creating the 3d assets on chain, we can update them with newer versions. But this living document sort of thing is an important part of that it's important part of assets is an important part of storytelling, video games, interactivity, components to work with each other. And that's just the data format. That's just the system's part of it. What makes all those things work is that computing is needed to maybe realize those things. You want to render a hologram of something that's in this archive in this dataset on chain, who would have GPUs and do that have AI? You know, fill in the blanks, recreate something with it, boot up the GPUs and give it give it that compute power. But the metaverse the thing that trips people up is Is it a web? Is it a 3d web? And I'm not so sure that it is I think it's great that you can go to a web page and have a 3d experience. I mean, Apple fully supports WebEx are on the vision Pro, you can go on safari, and you can folk, your eyeballs. But there's not a lot of like it doesn't let you to really bring things together intersect things that's the part that's missing, like the web was a huge boon for everything. I mean, all the things that are now appetite started Facebook, Amazon, Google, and the heck, even Apple didn't have an app store. Everything was a web page, back in 2007, or eight or whatever. And I think that led me to something like that. I mean, I, one of our advisors to the both projects both renderer and endo toy brand tonight created JavaScript created Mozilla created Firefox, they didn't have the brave browser basic attention token. We need standards for that. And the metaverse, I think when it's not tied to a specific endpoint, like holographic displays are one way of viewing it goggles or another, your phone and a web browser could be a third. It's what's behind it that matters. And it's interoperability of that that matters that's through my YouTube isn't trying to put my suit wrap party and that before it's why I invited him. And he and I think the same way like you want to be able to leave one world and go to the other and there needs to be enough standards, not just like on the format's and how 3d data looks. But how you interact with things. How do you how acid portability works. And that's by having things on chain where you can have royalty streams. That's why the crypto actually has a really important use



case. That makes a lot of sense. And we're still missing that. I mean, apples. What's interesting about Apple doing the vision pro isn't so much the hardware, it's the fact that they've effectively built an entire operating system with the same degree of focus, maybe more so than they've had ever had on the iPhone, or the iPad, which I think had maybe a few years of gestational development before they ended up at the point where they were shipped whereas this thing has been seven or eight years in development vision OS and it's it definitely going to be a 1.0 right but it is something where the ability to take things spatial Li and experiencing spatially and also have those exist outside of any one centralized data format is important. And also, the metaverse starts with the idea of something. And in fact, that's my deep focus, like, the more interesting pants have taken out, where I was like, Oh, you were so early, your 2009 patent on token based rendering, and billing was, you know, a great way of showing that you had the idea for render longer. But there are other things around like, you're totally your brain stem is totally separated, and you're just looking at, at thought vectors that are that are overlaid, as you look at things as you experience things, and those are then scooped up in you know, in a form that machine learning can then rebuild, represent for you. And those are not necessarily like, you know, concrete elements, those are things that are like this is the the neural networks that a speaker, the engram of have an idea of something and we need ways of visualizing that maybe at some point, it's gonna go away in the future beyond the light field displays, obviously BCI not intrusive, hopefully, we have a direct connection, your brain is able to directly visualizing it inputs into things. I mean, I had the chance to actually when I was winning, I had to give me 15 minutes to talk to Elon on a on a hill, married on his wife, and I did ask him about neural link. And, you know, the feedback I got from him was like, I mean, it's, it's a ways off before you get to the point where you're competing with bandwidth you get between computer to computer, but, you know, once I think he's done with getting this to work for medical purposes, and people, you know, parallel people walking again, the idea is that yeah, it's like something like that, that BCI interface can help, you know, previous even deeper experiences, but the software and the vision for the has to matter. And the metaverse is, you know, the word meta, it means beyond I mean, it's effectively beyond sort of any of this sort of more, you know,



formulaic aspects of video games, or even movies. It's, it's the, you know, when we love a movie, it's a story, and the visuals combined that give us some sort of, you know, they move us and that gives us the qualitative experience. And that's what's missing the metaverse, we need something that incorporates all of that and allows us to remix and compose that. And that's going to take probably a bit of time. One thing that might help is ai ai can absolutely give us exponential, you know, you know, power to organize things to create things to explore things. I look forward to that. That's That's how I see I factoring in in a positive way to all these things. Not to mention, you could have a story just like in the holodeck, where now all the NPCs non player characters can all have their own thoughts and their own experiences really big missing piece of how, you know, I would imagine Metaverse experiences where you can walk through the story and experience it would work if you had a very simple conversation or natural language parser engines on the other side of that. Yeah,

Jake 32:31

I mean, you talk about neuro link. And I've generally sort of in I don't know, if I read this directly from you, or just in sort of prepping for this conversation. But I get this idea that a large motivation for you is basically closing the gap between having an idea and being able to make something amazing. And obviously, we've seen, you know, one example of this in recent history is basically like, you know, Dali, where you put in a prompt and you get this like, beautiful piece of art. But what we're talking about now might be something where it's like, a hologram or something that's moving, or some graphics that are incredibly impressive. And, and just taking that and working both on sort of closing that gap and making it you know, a lower requirement for human time spent human education required, sort of things that people don't know how to do that they need to learn how to do and everything like that. And also on the other side of it at the end game, and like the product, just improving what that can be. And I feel like that's sort of a large part of what you guys are focused on. Another thing that was really interesting to discover, you know, we talked about earlier, you know, the scanning and what you guys are doing with light stage, and, you know, Oculus did it or metadata with, you know, with blacks and Zuck something that, you know, you mentioned you got you've got like every actor come in and



sort of do that for movies, whether it's Marvel or whatever. It seems that you had the like foresight on the importance of those individual actors, correct me if I'm wrong here, but like, basically owning their scans. Yeah. And that's not something that is like sort of overwhelmingly obvious to everyone. But now, when you see sort of like AI and deep fakes and everything like this, the authentication, and like provenance No, this is also important aspect of the render network. You sort of saw that like way in advance, so maybe you could talk about that decision and then sort of like segue that a little bit because I do you think it's relevant into how the vendor network enables that to be able to trace sort of ownership and authenticity and provenance back for all of these digital assets?

34:42

Well, I'll start with the with the you know, sort of where we started with getting people to own their own scan so I think the rock I mean, because so many movies he came in for you know, I don't know there was a couple of Disney movies, Jungle Cruise, whatever innocent you know, all the universal movies with them. Fast and Furious. It's like that Over time, he's like, what I just own my own scan RAS like my agent, right. And, and we had that idea before he brought it up, I mean, already had been sending people to have likely a chance they would own to plant the seed. Because obviously he's, you know, he's Italian and he owns I mean, web is massive, right. And even people that are his clients, he has enormous influence over so he actually helped us build it, we have the latest Lightspeed we have was actually something he helped us get going. It's here in the actual office seven right now. And the idea was just to do, you know, service work for movies, stuff, it was to give the actors that are built the ability to get scanned, and so they would own it. And some of them got it and some big names came in, and we have those scans, and they're there. And they've been there for a while, and we preserve them in like the Sarah genic freeze for at some point, they can be pulled out and used in anything. But a lot of actors didn't quite get it. And a lot of people didn't quite get it, they didn't get how important was and I remember that we had to sort of shut that down a bit during the pandemic, because obviously, nobody could go anywhere, and aren't ever sitting on it. But it's like, you know, you come back out of that, and you have this last year. And you have now the very moment we're in today, where it's



existential, you know, digital double scan and everything we're doing having that zone that I mean, aren't really laughing about, it's like, that's exactly what we were going for. It's like we were thought, how do we communicate this message, you know, this was like in 2018, or something. And now it's like, it's obvious. word rhetoric comes in, you know, everything that goes into an output an interview, if you talk with people creating something every 3d file is people does buy things from TurboSquid, or, you know, things like that, and uses that we have a record of first upload, we have a record of all the pieces that go into that render, so we can rerender it in a point. And the output of that is also composed, so you have proof of how something was created. And more importantly, you if you start to think about where that goes one layer further, if you have some of these lightweight scan, and remember, you have to assume that things are encrypted end to end, I mean, we've done now, you can see right here, like beautiful 4k Star Trek, the motion pictures, upside down blu ray minutes that were rendered on the render network, November 21 2014. When I got one of the frames, I just put them in one of my slides to show we have proof of how that was put together, you know, the upload from a paramount artists to with the Starship Enterprise, the canonical film model, all that mentioned that with actors, right, so we have a model of a if a person from their lightsheet scan, we have mL machine learning, right that maybe anime Saturd doesn't look back on their performance. But even rendering that on the renderer, which we are everything we would ever do for the vision Pro, we're no secret, we're building an app. And others can build apps and leverage the same system. They can go on the render network, and there's a permission system, right? I mean, even using an asset or even create or tracking how it works, from the scan of the person to how it's used. And we're focused heavily on faces. So everything with AI that's taking like, it's kind of animating that, whether it's on the original person's performance, or it's on another actor that they've given permission for the States, given permission for all of that is encoded in there. And if without that, I don't know how you prove anything. I think the problem with deep fakes is that Adobe's got the right idea, there's a lot of interest around their content authorization system, where content, you know, authenticity, which is just metadata. But it's one of the ways where at least every edit you're doing with Photoshop and inches, kind of recorded, it could be on chain, we have



that for, I think, what comes next, which is a layers of spatial computing, or rendering, or holograms or poor people, right, or scans, those are really important things. And I think my hope would be that at some point, you know, when you're seeing something that is generated, there is a little button that says, Where did this come from? Like, what's the source of this thing? Give me the you know, and if you don't have it, you really can't trust it. And it's going to become, I mean, you know, totally on sort of switch things around, like the blue checkmark, and Twitter was the thing of like, hey, this thing came from somewhere, somebody, this means something from a, you know, I mean, register 40,000, blue checkmarks. Now, anybody can pay to get one, whether that's an improvement or not, is up for debate, but I want to make it so that if you have something that is even just slightly edited, there's, you see where that that came from, and certainly with with video, yeah, there's, you're gonna see centers where, right out of the camera, you're gonna get a timestamp, some sort of digital certificate, and every edit made on top of that will, will be on chain, we could do that for 3d. That's where the render network has a secondary, equally important purpose beyond just the compute utility, that you will need to create things for the mission Pro or light fields, or any version of the metaverse. All of that is inextricably woven together. And it's really important when it comes to people's performances, their faces, all of it. And likely data isn't just that big scanning facility. It's something we can use to effectively take your face and map it to data that's been created on life stage and that you can use to drive it in Avatar that is, you are not you. But there's that's the thing that if you learning is that you could take you know, hundreds of samples of people skins and faces and we paid, you know, humans right to contribute to this have a royalty structure set up for that as soon as the sag after stuff is done. There'll be payouts to the first 100 that we didn't do 10,000 We just did 100. But you can create generative faces with that and if there's you know, you're paid to do that on the render network. There's a royalty stream that flows back to the to that person. That kind of stuff is exactly what you I think you know, the blockchain is absolutely useful for I mean, any other system could get lost to oblivion. And also bit rot is something we want to get decentralized storage and things is really important. Still not a solved problem, but getting there. Yeah,



Jake 40:14

it's interesting, we sort of plugged into this render network world through this probably what what would you know, as important as this is, it's probably the sort of the secondary appeal of the vendor network, the first being just making the market to facilitate, you know, basically supply and demand of GPUs. Can you sort of paint a picture for, obviously, you know, you've seen this coming for a long time, even, I think you said 2009, you filed a patent that was roughly on the subject of sort of decentralizing this marketplace. And that's, you know, Bitcoin came out in 2009, you couldn't possibly have sort of being you know, you're not foreseeing like a theory on and so on. Everything like that, that you're now utilizing to, to make the network actually happen. But the idea was there. And clearly, this is not a case. Like you mentioned earlier, people see, like, oh, NF T's are hot, I'm gonna go try to spin up a business plan for NF T's and go pitch. This is something that like, the need was genuinely there, and has only become, you know, increasingly supported by trends that are sort of increasing the demand for GPUs. And there's a problem with supply. Can you sort of paint a picture of that? Why isn't this more comparable to like, sort of, why can't people just like go to AWS or something like that? Why is decentralization like truly the solution in this case? And how do you see that sort of playing out from where we are now, very early, I think 2017, you guys launched sort of like a beta 2020, sort of more of like the public release. So very, very early, we haven't really even had like, a crypto hype cycle, which is when a lot of projects tend to sort of like, build steam in the public eye at least, and then that sort of become blasting or blows up for a lot of projects or whatever. So where are we now? And where are we going? I think in the render world. Yeah.

41:55

I mean, the patent may have been filed in 2010. But I'm almost certain I started to talk about my patent attorney in 2004. About the renderer. It was that it was that far back. It's 20 years old, as far as my, you know, my vision for why it just took me about five years, maybe file a pen, probably due to time and money at the at that point, but it is something where we didn't so AWS is a very important piece of of our trajectory. It wasn't like my plan was, I was thinking



decentralized. GPUs were the only way we're gonna get them because I didn't see anybody taking putting GPUs in the cloud. Seriously, I actually went on stage with the CEO of AMD in 2009. To get as part of it like you put me on stage, I'll show you all this great rendering technology I've gotten on GPUs, you need to announce you're building a petaflop of AMD GPUs. Give me that so I can build a data center of that so I can start this process going. And then he got Dirk Meyer, who's, yeah, brilliant guy got fired. And so Andy didn't come through Autodesk, which would make 3d software invested and oh toy. For cloud streaming technology. I built ancillary to rendering. And they then helped us get a meeting with Amazon. And Amazon was like, maybe if Otoy, build something prep for Autodesk and constrain 3d applications. Then we put GPUs in the cloud and make money on it. And Jules, you've picked whether it's AMD or Nvidia, and it was down to the GPU instance, that eventually launched on AWS in 2013. I helped, you know, I have validated or pickier than I would say, and before that happened around the time it was happening, Eric Schmidt or just like, sends them over to my place. And I show him octane running from, you know, to the cloud to a web page. He's like, I know that everything. I did not know this existed, I need to make sure Google GPUs are part of this. And I want to join you're, what you're doing. And I just caught up with him. Trevor, and I were just speaking to him about a month and a half ago, which is great. I mean, it's been about 10 years since you've been part of our journey. And so Google and Amazon and Microsoft, right, the big three all built GPUs. And the big problem was that those are expensive GPUs, they're still expensive. Nvidia, if you're going, you know, they do make the best GPUs for the kind of stuff we need in the data center. You can't take a GeForce card from BestBuy put it in a data center, you will it doesn't allow that. So as we were wrapping up, cloud rendering, right on AWS, even Google and others, and you had a partner like MSG, right, they before they were doing the MSG sphere, they're doing plenty of things that require massive, massive vendors. They were an investor in Oh toy. And I just remember there was a job that was, you know, along those lines in that framework, where it was like six months to complete, and they had to do it in three months. I'm sequencing all the GPUs in AWS. And Amazon said, We cannot possibly invest more duty, it's just too expensive. That's when I knew that I had to wind down, you know, cloud rendering, throw toys on AWS, or whatever, and maybe keep those but



like, there's no way to market this thing, like one customer one night would just saturate 1000s and 1000s of GPUs, and there's never been more than 10s of 1000s of views on you know, on the centralized cloud. So the render network was like, well, there's hundreds and millions of these cards that are just as powerful and probably 1/10 The cost was by somebody who could afford them that are out there and an Nvidia doesn't block anything. In fact, Jensen loves it. I mean, he put me on stage in 2013. Right as we were getting off Pain in the cloud rendering service going. And so that's where the render network came in. When we turned that on when I started seeing that there was a market for people paying for GPU power, just mining Aetherium cryptocurrencies, like oh, I can take your Amazon dollar, I can charge you the actual spot instance price, which is pinned to that underneath of that, and still pay you more than you would make mining Ethereum. So why wouldn't you want to make more money and that's it. So we got about a million GPUs signed up. When we launched this in 2017. Brendan Eich, he launched basic attention token earlier that year, he helped us kind of get the crypto part up and running. And yeah, we were in beta for about three years. The first customer was John Doe, crater, Photoshop runs Island worked with us on trying to get digital doubles for talking and lay in row one. And he needed to do something for the Hayden Planetarium needed it done in like hours, you know, was gonna take days rendering locally, flip the switch, he was our first customer. And it worked. And since then, we've been doing, I mean, I don't even know all the stuff that happens on because it's end to end encrypted. We just heard about it when there's a support ticket, but a couple of Apple keynotes, a bunch of movies, and MSG, sphere content. And of course, a lot of stuff that's gonna go on the Apple headset, are all being rendered right now as we speak, most likely. And it's been it's been an interesting journey. But to this day, we still allow you to have AWS, Google GPUs, I mean, they're partners, they've done a full and full announcements, but they're just a limited quantity, they're expensive. And you don't need those for a lot of rendering. And in fact, the Paramount made the decision to go into Star Trek, The Motion Picture, the remastered version on tier two, or tier three, which is end users machines. And it worked, it came in and out, and then at the end has now been scrubbed from the system. You know, that was the last remaining vestige, it used to be a big deal with Amazon, or it was actually Google that did a Marvel movie with with our cloud



rendering service for Atlanta, the Watson 2018. That was huge, because now it's running on the public cloud. We've now done movies, major Marvel movies made for you know, things different, I should say, major studio, big empty templates with your films that are done on average users machines, and therefore there is no limit, that means we can do anything and everything. Security is always important factor, it's always a risk. But it's it's, it's pretty secure. That's that's where the render network is at. And then we factor in AI, all the machine learning stuff, rendering and machine learning or go ahead and head in 2017, just finishing a render, we were one of the first companies to introduce AI D noising, which takes the render times down by 1/10, for 1/10 of the amount of time needed, it's still part of all the jobs we're doing. So rendering, you know, Ray tracing rays, and also doing machine learning is always gonna be a mix. And the demand for that with training and inference, and rendering are all you know, are all perfect. I mean, there's only a couple of very focused on on garbage language models, like TPT for that do require hundreds of millions of dollars in super high end each one hundreds, but there's probably 80 to 90% of the machine learning workloads, both training and inference that relate to images and media that can be done on a 3090 or a 48 gigabyte ASICs 1000s, which are out in the wild. Not to mention Apple has 120 GPUs that are going into into laptops, right. So I will pause there because that is my that is sort of my web of, you know, my idea map for, for women vendors sits on with all the public cloud GPUs that are out there and, you know, even included, inclusive of the crazy year that we've had with AI and the scarcity of GPUs, that's, that's become really prominent and well understood. And in those past 12 to 13 months,

Jake 48:18

yeah, it must have been pretty interesting for you, like, you have these seeds of ideas. And then you see, like, you know, the LLM is common sort of with a bang become a big thing. And then you see, you know, like NF T's and that's getting all these ideas about continuity that you've been thinking about for like a long time. So it's like impossible to, or at least very difficult to see, like, the exact way that this thing is going to be introduced or when, but you're clearly like playing in the right stadium and playing the right game, basically. And this sort of potential for render seems it's pretty



hard for me at least to like, wrap my head around. It's, you know, it's also like, you know, there's science, there's rendering, there's like, various different applications where I think it's not, we've talked a lot about like, sort of the entertainment industry and sort of like VR and the apple headset, and NASA

49:03

uses it, NASA renders their, their animations on the render network, like for the ISS. And I mean, it's crazy. I was shocked when I saw that I was like, wow, I didn't even know they were using it. So yeah, I mean, there's so many applications that are obviously well above and beyond the media entertainment space.

Jake 49:21

And it's just crazy. So I know we're coming up on time and I want to be respectful. I really appreciate you taking the time that you have last question before we wrap up and then maybe you can just sort of end by telling people where they can go to learn more and everything like that but being such a long term thinker thinking 20 years ahead, you know, and having been doing that since you were a teenager basically I want to hear you know what you have in mind for like the short term actually like what you think is most feasible and around the corner, whether that's you know, in regards to render network or what you're doing it oh toy or, you know, more at the metal level with what's going on with Apple or open AI or neural link or whatever it might be what's got you excited for like, you know the rest of the 2020s? Let's come on. I'll give you an extra two years. So seven Oh, wow.

50:04

That's a long time. That's like a that's eons and all these things. But let's start with a very short term. I mean, the Apple headset going out next year is is is a big deal. I mean, I was equally excited when Carmack was pushing, you know, Oculus 10 years ago, and that was something that was going out there. But I mean, Facebook is not Apple, they're very metaphoric using the different companies, they have different approaches. Apple is taking this very seriously, they get it for them as a long term play as well. This was the beginning of something, um, you have to imagine that let's say that this thing Waze



is heard about, it's, you know, maybe it's not frictionless. But imagine that it's a pair contact lenses in 2029, right? I mean, that's pretty aggressive. Maybe it'll take another 10 years to get there. But it will be something like that you can see an operating system that's designed for your eyeballs to no screen start to emerge from a company, that's the most valuable company in the world, that's a big deal, we're 100% focused on that render is huge part of that you need content for this thing, you will need to go to the Render network to make it happen. We need that I know we have a ton of GPUs here, locally, it's just you just need it. That's the first thing that I'll say is imminent. Light field displays are going to happen at the high end. I mean, you know, location based entertainment, theme parks, those things will also leverage the render network for those pieces. People wants to do, you know, physical pieces, right that are doing OLED screens that are very cleverly tracked what you're looking at. So it looks like a hologram. But when you can just have it be a hologram. And it looks like a piece of physical art mind blowing, whenever those things, whether it's by the end of the decade or not that you get to holographic displays that don't require goggles that are totally just, you know, friction free. I mean, maybe those those going to high end, you know, home theaters, that would be a big deal. On the AI front, I would say that renders a huge part to play in that there's so much to be done. On the visual on the media side. I mean, I'm MLMs are another layer entirely. And of course, you do have things like valley that are plugged really nicely to check EBT. But you know, you look at one of the things that open is doing really well is they're creating a plug in system like this. And you're just now to create your own CPT, terrific, like, I think check up for us fantastic. Like I can imagine, finally, things I could do with it connected to render, and watch something in the next three months that I wanted that I'd like to see happen. Right. And that's great. I mean, you know, you can always swap out on a limb or render like we have it's part of the renders on render besides one Oh, 28. So there's, there's tons to be done there. And I do think, though, that a lot of what's going to happen is there's still a missing piece in generative AI, which how do you generate a beautiful, perfectly quiescent 3d scene? Oh, twin needs to solve that problem. I mean, if we don't, somebody else will. But I think we can get there really, really quickly. And the way that it's mattered is on things like the vision pro at first, and then it'll



it'll emerge into other forms and other factors as like light field displays, and other things come to him to come to happen. But the part where we can let people experiment with AI and generate AI in a visual way, I mean, I think that plugging into other other models, supporting any arbitrary type of AI is helpful but there's a really such great pieces, the render networks, I think value proposition is why it's bigger than just Oh, toys, it can ingest any, render any software stack, as long as there's some sort of system or model that allows you to compose these things. That's, that's the piece that I think we're gonna be focused on a lot in the coming year, both to the OTA side, both in the render network side. And also just as part of like, we're part of five or six different standard bodies and editor standards forum Kronos, you know, Academy, software, foundation, all those things are important factors to help identify and increase these standards. And the reason we're also on Solana is that, you know, Russian totally had been great about helping us, I mean, they're able to build things on chain that I think are useful for the things we need on the render network, but also those who could like become standards for you tremendous versus, and if he's even if they're adopted another chain. So that's all things that are in like, the next 1218 months, by the year 2029, I think we'll have we'll probably have a pair of pretty robust glasses, we'll probably have a lot more light field displays more probably have a lot more AI, it's able to, to fill 90% of the work. That's busy work right in the creative process today. And we'll see. We'll see how that plays out over the next seven years. Awesome.

Jake 53:59

Well, I know we're up on time but again, I really appreciate it it's been a awesome conversation and it's just been fun trading ideas. I think you've gotten a really interesting view of the future and it's been great reading it and now getting it in person or rather you know, in real time so really appreciate it and yeah, I guess anywhere else you want people to follow you I know you have the domain name x.io So you the ones got x.com

54:21

You've got x.io I can actually a long time ago



Jake 54:24

yeah you beat you beat him to the punch I guess and then you know vendors on Twitter and you're on Twitter or anywhere else you want to send people before you

54:32

know like Twitter Nanos X you know, actuals are back at Oh toy, at render network those if you follow our social media links, those three will get you probably connected all the other, all the other pieces, so I would start with them. Perfect.

Jake 54:45

Well, thank you very much. I really appreciate it. Thank

54:48

you so much, Jake. It was a pleasure.