

FIELD OF VIEW PODCAST – THE GRANDFATHER OF VIRTUAL REALITY AND THE FUTURE WITH TOM FURNESS (S1E12) AUDIO TRANSCRIPT

SPEAKER: Brought to you by Accenture Extended Reality. This is Field of View.

NICK ROSA: Hello. My name is Nicola Rosa from Accenture.

DANIEL COLAIANNI: And my name is Daniel Colaianni from the Academy of International Extended Reality. And you're watching or listening to Field of View where we speak to really interesting people about the observable world of extended reality. This podcast is all about deep diving into these people's lives and, I guess, how they entered the world of XR, but also talking about how it's got a real impact on you now and in the future as well.

NICK ROSA: And you can find the new episodes every two weeks on YouTube, Spotify, Apple Podcast and Google Podcast. And it's a very special day today, Daniel, because we have someone that has been recognized as the Godfather of VR. We have a true pioneer of this technology. We're going to deep dive into his past and the initial research that he's been

doing. And we're going to talk about the present technology and we're going to talk about the future of this technology. And I'm super excited about introducing our next guest. Daniel, would you like to do it.

DANIEL COLAIANNI: Yes, certainly. We've got Tom Furness. Welcome, Tom, to the podcast.

NICK ROSA: Hi, Tom, thank you for being with us.

TOM FURNESS: You bet. Thank you.

DANIEL COLAIANNI: So, Tom, for the very few and I don't think it's going to be quite few in terms of those who are already in the industry, but those who aren't in the industry also listen to this, who are you? What makes you say - why is Nick bigging you up so much? Why do we have you on this podcast today?

TOM FURNESS: Well, I guess I'm lucky enough to have been around a long time working in this whole field of what we call extended reality today. I started my journey in 1966 and I've

been working in VR, AR, XR, MR, whatever you want to call it for now for over 55 years. So I guess it's because I'm an old guy that's been around a while working on this, that I've been labeled as various things, Dumbledore, the Grandfather of VR, the Godfather of VR, as you mentioned. And I didn't really seek for those titles. I guess it's just because I'm old - this old guy that people want to say, well, he was there a long time ago and that's how it happened.

NICK ROSA: Well, Tom, that is very down to earth of you, but I mean you've been working on some very groundbreaking and pioneering research. You founded the Human Interface Technology Lab and you've been working on this technology for something like 60 years now?

TOM FURNESS: Well, about 55 years, yes.

NICK ROSA: 55 years.

TOM FURNESS: Yes, and really you could say that I've had sort of three sections of my career. I mean of my life, then the last two sections had to do with VR. Of course, the first one was just growing up and going to university and things like that and then what happened after that, working for the Department of Defense. And then after that working as an academic and entrepreneur and things like that. So we can talk about those three stages of my life if you want to as we go along.

NICK ROSA: Absolutely. And we would love to know a little bit more of the stuff that you're doing right now because we know that you started this Virtual World Society and we're going to deep dive into that a little bit more in the second phase of this podcast. But, first of all, can you tell us a little bit about your origin story? What took you to work on VR, like analyzing the first year when you joined the Air Force to understand how to create what has become the first HUD? So the Head Up Display

that's right now all the fighter jets and fighter pilots are using on their fighter jets.

TOM FURNESS: Well as it turns out, HUDs were around when I came on the scene, but in 1966, no one knew or there wasn't any virtual reality. There were virtual images. As a matter of fact, that's where virtual reality comes from is this notion, optical physics of virtual images. Now virtual images are images that you see that appear to be located at some place in space, but they aren't really there. They just appear to be there. And so, that's where we got this notion of virtual interfaces and then, that morphed into what we call virtual reality because it could become a substitute or simulation of reality.

So I mean way this happened was I didn't intend at the beginning to create what we now know today is virtual reality. I was just trying to solve problems that I saw in my tenure as working for the Air Force. After I graduated from the university, I was commissioned in the Air Force as a second lieutenant and assigned to Wright-Patterson Air force base which is the mecca for military research and development. And as it turns out, in this case, I also spent a lot of time at Farnborough working with the Royal Aircraft Establishment and actually doing some testing on various Royal Air Force aircraft. I can tell you about that a little bit later.

But my job, first of all, was a flight test engineer. I was flying into fighters myself and testing equipment, electronic intelligence equipment and things like that and as I looked around in these cockpits and was operating a lot of these instruments, I said, wow, this is sort of archaic. This is very intuitive these cockpits. You have 300 switches and 75 displays and 11 switches on the control stick and nine switches on the throttle and you're pulling G's at the boundaries of consciousness, flying twice the speed of sound and being shot at, at the same time. So it was sort of a busy place to work.



And so, it was clear to me that we need to do something about getting bandwidth to and from the brain of these pilots because it would just - the information was not organized very well, you had to spend a lot of time training. And so, I really turned my attention from flight test engineering to cockpits, designing cockpits. Actually that was a lot more fun and I was still flying in these in these jets, testing some of this equipment. But the problem became how in the world do we put information into the sentry and organs of this pilot during these very difficult environmental conditions? And so, what came from that is an adaptation of what we were doing in terms of head up displays and basically moving the head up display into the helmet.

So you could actually move the head up display around and then you could track it at the same time to know where it was located. Because there's always a problem in fighter aircraft. We were having to aim the whole airplane in order to aim the systems on the airplane. When, in fact, you can aim your head and know where things are located and put that information, that line of sight into the aircraft to aim various systems, weapons, radar fire control system and various other sensors. As well as, with this moving head up display, you can then project information over the outside world wherever you happen to be looking. And with this combination of this closed loop where you're displaying information and always knowing where it is, you can then stabilize it in space. So as you move your head around, it stayed in one place in space or it would be in space or it would be located - move with your head, be stable with the cockpit, whatever you wanted to do.

And so, this became this universal portal into what we call a circumambience of information that can take the place of the real world. For example, if you're flying at night or something

like that, or it can be superimposed over the real world to add other information. For example, to see the invisible with infrared or other electronic sensors and things like that.

So basically, the bottom line of the origin of virtual reality for me, at least, was in trying to solve problems in a cockpit of fighter airplanes. Now that eventually migrated into lots of other vehicles, into the space shuttle, into tanks and to submarines and things like that. But I was basically - my laboratory at Wright-Patterson Air Force Base became the center for developing these virtual reality technologies in the early days. And a lot of the developments we did, fundamental developments, we paved the way for the industry that we have today.

DANIEL COLAIANNI: So, Tom, I'm interested to know before you kind of joined the Air Force and stuff, what was your exposure to things like virtual reality and augmented reality?

TOM FURNESS: Well, it didn't exist. I mean I was - as a kid, I was one of these nerdy kids that loved to play with technology and we really didn't even have transistors back in the time when I was growing up. Everything was done with vacuum tubes or valves, but I loved - in my neighborhood where I grew up in western North Carolina, I sort of - I was in in paradise for a guy like me because I love the outdoors, my home bordered on the Pisgah National Forest and I would take my dog and the two of us would go out and just be gone for days, just hiking, camping around on our own. I can't believe my parents let me get away with that, but it was just a great place to grow up. We had a great neighborhood, had all kinds of sand lot baseball games, football games, things like that. But I was really for some reason I had this quirky gene that I was interested in electronics and what really peaked it was in 1957, I was in the seventh grade, was the so-called International Geophysical Year. And this is when all the nations were going to get together to



orbit some satellites to look at the earth, to try to characterize what's going on up there. And up to this point in time, we've just been shooting rockets up, radio sound rockets and things like that to do some samples, but not orbiting. So 1957, was a big deal and this was about the time that NASA got organized, that we were going to do this with non-military vehicles. Now there were military missiles that existed, but the U.S. decided, no, we're not going to use the military. This is going to be a civilian organization and it was going to be the United Nations and things like that.

Well, of course, what happened was the Soviet Union used military rockets.

NICK ROSA: Of course.

TOM FURNESS: And they orbited the Sputnik. And so, here was the Sputnik running over the earth and the Russians beat us to it and everybody was terrified. I mean my parents and others would say, oh my goodness, the Russians are overhead. And actually, I thought it was pretty cool because what I do is I built a shortwave radio to tune in to the signals coming, the beep, beep, beeps that came from the Sputnik and things like that.

And so, it was after that, of course, we tried to launch our Vanguard rockets and I think the first two or so blew up on the launch stand and that was sort of embarrassing, trying to orbit this this grapefruit size satellite. But eventually, Wernher von Braun came in and said, well, let's just use a Redstone missile and we'll orbit this explorer satellite, which we did. And then after that, a few years later, President Kennedy said, we're going to go to the moon. Now that was sort of a bold statement to make because we really hadn't – I don't think at that time, we'd done much - I can't get my timing right, but we just had put someone into a sub-orbit, Alan Shepard.

And so, here then Yuri Gagarin goes in and does three orbits around the earth and we just only get a sub-orbit going. So we were way behind, but President Kennedy said, we choose to go to the moon. Wow, that was so cool I thought. Now again, I'm a teenager. I'm a young teenager and so, what I started doing is I fell in love with rockets. So I started making my own rockets. And I'd shoot them off in the backfield near my house and they were sort of little and dinky and whatever I could find and I sort of created my own rocket fuel from my chemistry set. And I sent my mother to the pharmacy - actually I ordered my chemicals from the pharmacy in order to - so I started launching these rockets and most of them blew up on the launch stand. But I came up with electronic means to launch them and things like that. And then I decided, well, I'd really - it'd be fun to find out what's happening in the rocket. So I started building this telemetry stuff, these electronics that would go in the rockets and things like that. And I entered this into the science fair and I won. I won the State Science Fair and so, my prize – I was just a junior, you know in the 11th grade, 11 out of 12 grades in the U.S. a

And so, I didn't get the big prize, but the prize I did get was the so-called Navy Science Cruiser Award, which meant that I get to spend a week with the Navy. And here I was this kid - I was 16, 15, 16 years old and they put me on an aircraft carrier with all these jets flying on and off the carrier. And they had a bunch of senators on board at the time and there was a kid - one kid from each state that had won this prize and we were there with the senators and they were doing these air shows out in the Atlantic Ocean and dropping bombs and shooting missiles and things like that.

And so, that was so fun.

NICK ROSA: I can imagine.



TOM FURNESS: As a teenager to have that. And so, I came back and I wrote this this sort of an expose of what my experience was, just this little story about what happened to me. And it turns out that the Navy picked up on this and they wanted me to be on a television program. So at the North Carolina public television station, they invited me down at a particular time to talk about my experience on the Navy Science Cruiser Award. And I did and then after it was over, they said we have a special event for you, a special opportunity. And they took me over to the Moorhead Planetarium. This is the unit on the campus of the University of North Carolina. They took me over to the Moorhead Planetarium and there were three Mercury astronauts.

NICK ROSA: Oh my God.

TOM FURNESS: Who were practicing celestial navigation. They had a Mercury capsule in the planetarium and they were shooting stars, you know to learn how to navigate in case computers fail or whatever. And so, here I was this kid, this 16-year-old kid, with three Mercury astronauts, Alan Shepard, John Glenn and Gus Grissom. Wow, I had an hour, just me and these three guys. I mean it was like hog heaven. I mean it was like paradise and being able to talk to these guys that I so respected. These were my heroes. And I decided I wanted to be one of those guys. I want to go into space. I want to be an astronaut.

And so, what happens is that the rest of my high school, that's what I planned. I'm going to become an astronaut. And so, when it got time to graduate from high school, I was going to go to the Air Force Academy because the whole plan was what I would do is I would go to the Air Force Academy, become a pilot, then become a test pilot and then apply to the astronaut core because that's the way you you'd get there, at that time at least.

So what happened was I got my conditional appointment to the Air Force Academy, congressional appointment, I went for my eye test, I had to pass the physical, went for the eye test and I couldn't read the line I needed. One line, if I was able to read that line - just the lower line, I'd be in. So I was crushed. I didn't even have a Plan B. So all the things that I had aspired to do, I didn't get a chance to do. I wasn't going to get a chance to do.

So I ended up going to Duke University, which is a much better school by the way than the Air Force Academy and in engineering. But I enrolled in Air Force ROTC because during the Vietnam War, I was going to go to the war. I was going to get drafted, go to the war regardless. And so, I decide, well, if I have to go, I might as well go in the Air Force.

So I got commissioned when I graduated, and as a second lieutenant, as I mentioned, electrical engineer and they sent me to Wright-Patterson Air Force Base. Now Wright-Patterson is probably the world's highest tech center having to do with military aviation bar none.

NICK ROSA: Fascinating.

TOM FURNESS: And when I showed up for my assignment, my duty assignment, it was an interesting day. I went in and reported to with my brand new uniform, my brand new gold bars as a second lieutenant, went to the personnel office and said, okay, I'm here, here are my orders. I'm here, what's my assignment? So the personnel guys looked down the list and they said, huh, said you're not on our list. All the lieutenants were coming, showing up, and I said does that mean I get to go home? And then, no, no, you have your orders to be here and so, they looked on this other list there were 12 lieutenants. They said, oh, here you are. You've been assigned to the Lieutenant's Education Application Program. Oh, okay, what is that? You get to work anywhere you want to.



DANIEL COLAIANNI: Oh, wow.

TOM FURNESS: You get to choose where you want to work at Wright-Patterson Air Force Base. And what we recommend is that you carry your slot with you, that what you do is you interview around and find maybe the first year of three places you'd like to work and then, just pick one of those for the rest of your tour, for a total of four years.

DANIEL COLAIANNI: And was it common for things like that to happen?

TOM FURNESS: No, this was a special program to get I guess engineering lieutenants excited about maybe having a career in the Air Force.

NICK ROSA: Fantastic. Have you been working on the Blackbird?

TOM FURNESS: I can't talk about that.

NICK ROSA: Wow, okay. So when you told me, I mean the most advanced facility in the Air Force, I mean, wow, incredible, incredible.

TOM FURNESS: Yeah, so what happened after that was I planned to spend my time in flight tests because I wanted to fly, to go in the flight test engineering. I wouldn't be a pilot, but I would be a flight test engineer which meant now I'm flying the jets and run the equipment and do the testing of whatever. And so, that's when this happened that I started seeing how these cockpits were designed and that they needed to have this change.

Now, I'm going to get back to space toward the end of what really happened in terms of going into space. But that's what happened, I mean there was no virtual reality. But what there were problems that needed to be solved and I had, as a kid, I was in addition to being just excited about rockets, I really had this - I was probably the only kid that my age that read science fiction and I loved these alternative worlds and things like that. And I remember

that what I would build is pretend robots. I'd have this robot I'd make out of cardboard and had eyes and had ears and things like that and I would position it somewhere out in the yard or around. And then I would have another box that was my control panel and I even had this idea that when I moved my head in my control place, the robot's head would move out there. Pretend, you know, I'm not - I couldn't build it physically. But so, I melt all these out of my erector set these control panel and I would sit there just for hours pretending to be looking through the eyes of the robot out there in my yard and moving around at various places. All this in my imagination.

NICK ROSA: And now it's possible.

TOM FURNESS: That's right. That's right.

NICK ROSA: And thanks to your research as well and would you like to tell us a little bit more what happened after your years in the Navy? I mean you joined the Navy, you worked on this Air Force - sorry, you joined the Air Force and you worked in this breakthrough technology to embed HUD inside the helmet and a laser pointing system inside the headset and so on. And then you moved to the academia world which is a completely different world.

TOM FURNESS: Well, let me tell you that story. So here I'd been - I was in the military for five years, wearing the blue suit as an officer in the Air Force. I became a captain at the end. And then it was time for me to go home. I had served my time. And the laboratory for whom I was working said, why don't you stay on as in a civil service position, doing the same kind of work and we'll give you a promotion? And these you'll have your own test airplanes and things like that to work with. And I thought, that sounds like fun. So I decided to put off - take off my blue suit one day and just put on my civvies and continue on that work. And that's when we really got to really busy working on the



foundational things associated with the technology. Lots of things that we did, too many to number. But then came in the early 80s, we've been working all this technology, we've been flight testing things, proving that would work this virtual reality, putting the tracking systems and the display systems and eye tracking and all this stuff together, building various simulations. I spent a lot of taxpayers' money and then we had this what was so-called Project Forecast 2. This was where the Air Force is sort of a think tank, where they gather civilian scientists and military scientists from all over the Air Force and we went to Washington, D.C., the Pentagon area, Crystal City and we thought about the future.

And in that process, in one of the groups I was working in, back to this bandwidth of the brain, I said what we really need to be building is a cockpit the pilot wears, magic flight suit, magic helmet, magic gloves that generates the circumambience of information. And I proposed, as a project, a super cockpit, the super cockpit is the cockpit that you wear. And so, there are a number of these projects that came out of Project Forecast 2 and here we were with briefing a panel of generals, who needed to decide which ones they were going to pick to actually invest in.

And so, I had basically five minutes to pitch \$130 million dollar program.

NICK ROSA: Wow, Shark Tank.

TOM FURNESS: Yeah, this is Shark Tank on steroids. And these are you know four-star generals that was sitting there. And so, I pitched this super cockpit idea which was so far out that I can't believe that they would even think about it, thought it'd be too outlandish, but that was one of the two projects that they funded. And so, now I was the project manager of this big project to a build cockpit that you wear.

NICK ROSA: And can we remind to our listeners or viewers which year was that?

TOM FURNESS: This was in about the 1984, well, the super cockpit stuff started in the early 80s.

NICK ROSA: So we were in the Commodore 64 era basically?

TOM FURNESS: Yeah, right, right. And so, I built the super cockpit simulation was this huge annex helmet. It looks like a Darth Vader helmet, that generate 120-degree field of view, stereographic, with 16-bit magnetic - electromagnetic tracking, using miniature cathode ray tubes, miniature television picture tubes, 15,000 volts on each side of your helmet, projecting all of this with this electromagnetic tracking system, speech input, eye tracking, hand tracking all this stuff. This is in the early 80s, we're doing all of this.

DANIEL COLAIANNI: What kind of specs are you working with here? Like in terms of the hardware that you have to use, the memory and things like that?

TOM FURNESS: We had to make it. We had to make it up. And we were using digital equipment corporation VAX computers. For our simulation, we had eight VAX computers and a shared point memory and we had two PDP-11's, hook to Evan Cylinder Picture Systems. One to draw the left eye, one to draw the right eye and this is all done with vector graphics.

NICK ROSA: To provide stereoscopic?

TOM FURNESS: Stereoscopic, that's right. And I mean we had these miniature TV picture tubes that were about one inch diameter, that would generate 1,200 TV lines and had to use water cool electronics because they ran so hot, that we had to cool them with water. And we had the three-dimensional sound that we were using by with binaural sound synthesized sound,

things like that. And it was amazing and actually the first day that my troops - we've been working on this for several years, put all of this together and do the smoke test. This is when you turn all the switches on to see if it's going to work.

And when I got a chance to sit in the cockpit, I had this helmet on, this huge helmet. It weighed about 10 pounds within the gator spring assembly that sort of suspended it to keep all that weight from being on your head. And so, for him to switch on it this huge picture unfolds, this is the first time this has ever been done on the history of earth. And then you look around and I just about peed in my pants. I mean it was unbelievable. It just took my breath away, I knew it was going to be pretty cool, but I didn't realize how powerful this was. It sort of like pulled me out of the cockpit seat and put me into a world. And so after that, we were just blown away with the power of this technology and even brought in fighter pilots from Edwards Air Force Base, the real test pilots, and had them fly it and they said, wow, this is world changing in what we're doing.

DANIEL COLAIANNI: So when you look at things like, I guess, when like Velis kind of announced what they've been able to do with - I think it was a EASA kind of getting actual approval for the flight cockpit, like using these kind of like simulators and things like that for actual like flight hours and stuff within Europe and stuff. How far-fetched would that be as an idea of kind of back when you had the super cockpit as well? And I guess how would you reflect on that now?

TOM FURNESS: Well, I mean we could have done that 20 years ago, 30 years ago, what they're doing now.

NICK ROSA: Why do you think they didn't?

TOM FURNESS: Because they didn't have the technology to begin with. Second of all, is

expensive. Third of all, it was really unproven at the time. So I think it took this growth over the years of testing it because this is like no other medium that's ever existed. It is one that unlocks spatial awareness, it matches the way that we basically see the world. Anytime we're putting the world into two dimensions and looking at screens like we are now, that's not the real world. The real world is three dimensions and the real world is big, wide fields of view. And when you have those kinds of capabilities, you're able to get bandwidth to the brain. And we've known that for a long time, the problem is making it practical.

And I think what we're seeing now is it's now really practical to do those things and affordable. And we have what's made it practical affordable is really the computational technology we have to go with. You don't need 11 computers, 11 VAX computers to make this go. You have what's in your smartphone and with the computational capacity the graphics ability we have and it's really good. Until we got to the point where we had low latency and we had this computational capability, it really was not practical. So even though we knew it would work, it was actually making it work practically.

DANIEL COLAIANNI: I was going to say, you must have built up a really high tolerance to motion sickness?

TOM FURNESS: Well, you can make a person sick with VR if you don't do it well because generally what makes people sick, motion sick or simulator sickness we call it, is when there is a conflict between the sensory inputs. For example, if you have a moving world, if you're starting to move the world and your eyes are looking at this world going by, your eyes are telling the brain I am moving, but your vestibular and organs, the semicircular canals and your otoliths and things like this in the inside your inner ear say, no, you're not moving. So you have these conflicting signals going to



the brain. One is saying you're moving, the other saying you're not moving. And what that usually means is you've eaten mushrooms. You've got something going - so what you do is barf. You get sick as a result of that now.

So what we've done now, you can still do that with VR, you can still - causes conflict, but people are wise to that now. It's not a good idea to translate into virtual world unless you're walking, physically walking. But if you're sitting and you're moving, what you want to do is hop to places. And so, you try to teleport to another position rather than moving yourself to that. So there are ways to solve that and we know those things. We've proven them.

DANIEL COLAIANNI: But you guys had to, I guess, do that with trial and error, right?

TOM FURNESS: That's right. We had to barf a lot to get there, but we knew that it all had to do with getting the speeds up and getting the latencies down because you'd move your head and there would be a delay in the picture moving. And so, you'd have this sort of garden hose effect. You go in oscillation. And so, once the computational capability came and the resolution started going up in the displays, you're able to have a much more compelling and more realistic and less disturbing experience.

NICK ROSA: I suppose that's when LCD displays started being available, you had a sort of a breakthrough with the miniaturization of those devices, like making them more portable and so on. But this is so interesting, I mean it seems to me that you had to tackle a lot of problems that were far beyond the computational power and the optics and the tracking. We're talking about the optic feedback for the pilots, the creation of user experience guidelines for usability and comfort and so on.

TOM FURNESS: Yes and, of course, a lot of this was shrouded in classification and we couldn't

get the word out about what was going on. Let me tell you a little bit of story about that and this was what transitioned me into the third state of which is becoming an academic. And so, what happened was -

DANIEL COLAIANNI: This is like happening more towards like the end of like 1989 now?

TOM FURNESS: Yes, yes. So what happened in about '86, I got a phone call actually '85, I think it was. I got a phone call from a general officer at the Pentagon and we had already been working on the super cockpit project and it was we're having some success and getting that underway. And anyhow, I got this phone call and this general said, we'd like for you to hold a press conference and a press release on the work that you're doing in your laboratory because we need some positive publicity. It come out in the news that the Navy was spending \$800 for toilet seats and the Army was spending \$500 for hammers. And he says, you know, the Defense Appropriations Bill is coming up and we are going to get hammered in Congress. And that's usually when we unveil something that we've been doing behind the scenes, a black airplane or a black ship or something like that. And he said, but we don't have anything black to unveil this time except what you're doing in your lab. And we want you to do this and I'm saying, well, but this is classified work we're doing. He said, just declassified it. Okay, at least certain parts of it.

So I wrote up this press release and the news team from CBS Evening News network television came. I spent two days taping my super cockpit stuff at Wright-Patterson Air Force Base. So I end up on the CBS Evening News talking about virtual reality and virtual cockpits and this is in 1985. And after that, it opened Pandora's Box because after that, all the networks people had to come, ABC and NBC and CNN and CBC and BBC, the Science Center, The New York Times came down and spent a

day with me talking about the implications of all this technology.

And I started getting phone calls, I don't know how it happened with the switchboard at Wright-Patterson Air Force Base, but people would call Wright-Pat and they'd vector them with me, I watched that program on television. This mother called and said, I watched this program on television where you're talking about your virtual cockpit stuff and my child has cerebral palsy, is there anything you can do with that technology to help my child?

And then a surgeon called me, says I'm a thoracic surgeon. I'm inside this patient trying to do a graft on the aorta and I'm up to my elbow inside this patient and my navigation system, my map, is a CT scan on the light box on the wall in an operating room. I'm looking over at that trying to figure out where I am, is there any way that you could sort of put that map inside the patient.

Then another surgeon was calling me said, I'm trying to do a minimally invasive surgical procedure, I want to be in the inside looking out, is there any way you can put my eyes inside the patient?

NICK ROSA: People thinking about use cases?

TOM FURNESS: Well, yeah, and then an anesthesiologist said, you know, we have this real problem in the operating room is so complex with all the instruments going on, the anesthesiologist has all this this data, any way you could build a super cockpit for an anesthesiologist?

A firefighting company called and said, we have this real problem with firefighters. They're going in these buildings, they don't know the layout of the building, the building is full of smoke, they don't know if any people there, they don't even know where the other firefighters are and the fire chief, who's

directing all of this, is on the outside of the building with the radio and doesn't know anything. And firefighters are losing their lives and people in buildings are losing their lives, is there any way that you can use your technology to help us see through the smoke?

Well, you know, and they were asking me these questions and my answer for every one of them was, well, yeah, you could do that. In fact, that'd be sort of easy to do compared with what I'm trying to do. And that's when I realized we're talking about something big. This is transformative. This is basically like splitting the atom. We are building a transportation system for the senses that's never been there before. And so, at that point in time, I queried my management, my leaders and said, hey, you know, we need a long-term development strategy of what we're going to do with this technology. There's so many applications, both inside and outside the military. And I'd like a chance to sort of explore those. And so, they gave me a sabbatical basically, one year off for my job. I had my second guy that sort of took over while I was away. They gave me a travel budget, I could go anywhere I wanted to. I was wearing my DOD badge, of course, and I got into places to find out what's going on with technology.

And I went everywhere. I went to aerospace companies, to computer companies, to hospitals, to kindergartens, to toy companies, everywhere. and I came back with this understanding, something huge is about ready to happen. And this is in the '87 time period, something big is going to be happening. We're right on the cusp of basically mini computers and microcomputers, telecommunications, fiber, all of these things are coming together from a computational standpoint, but no one is working on the interface. And that's where the action is going to be to get the bandwidth to and from the brain.



So I came back after that, I said, hey, you know what we really need to do is build a center of excellence on this human interface technology, somewhere in the U.S. outside the military, at a university. And they said, okay, that's interesting, which university? I said, I don't know yet. So I put together these plans and I started shopping it out to the universities around, MIT and Caltech and Stanford, Carnegie Mellon, University of Texas, University in North Carolina and the University of Washington. And I got phone calls from several of them, but the best one came from the University of Washington. They said come out here and give us an idea what you're up to, what you'd like to do in terms of this human interface technology laboratory.

And this was in the early part of 1989 and so, I did and I met one of the guys that not only the Dean of the College of Engineering, but a guy that was sitting right next to him when I walked in the room, his name was Ed Steer. Ed Steer was the Director of the Washington Technology Laboratory which was part of the State of Washington, with the intent of trying to build bridges between the university and industry. And they were sitting together and I looked at him, I said, don't I know you from somewhere? He said, yeah, I was the chief scientist of the Air Force and I was at your laboratory at Wright-Patterson Air Force base. We want you to come to the University of Washington and this is what we'll do. We'll bring you as a full professor with tenure. We'll give you a \$2 million startup package and a whole floor in this new building that we're building, to set up your lab.

NICK ROSA: Lovely.

TOM FURNESS: And your whole charge is you build stuff and become an economic engine for the State of Washington. And so, I moved to Seattle in 1989 to begin the Human Interface Technology Laboratory and now, there's another laboratory in New Zealand, another

one in Australia and there were supposed to be four of them in the UK. There's a story about that I'll tell you someday.

NICK ROSA: Okay, where are those laboratories now?

DANIEL COLAIANNI: Yeah, I want to know where they are.

TOM FURNESS: Well, as it turns out, I was invited on one of my sabbaticals - I did my PhD in England, by the way, Southampton and it was great, great experience, we loved it and my family and I loved it. So we would return and the most sabbaticals I would return to UK in various places. And so, the Advantage West Midlands, Birmingham, asked me to come do a sabbatical there with the idea of setting up a human interface technology laboratory in the West Midlands. Because what it was is basically, you know, we'd spun off 27 companies here in my lab at the University of Washington. These companies became the core, the nexus, of the virtual reality industry, XR industry. And they said, why can't we do that? And I said you can, you just need to figure out a plan that there's a combination of the university, a research center and then a company that would take that IP and then take it to the next steps to where you spin off the real companies that make it.

And so, we, in the process of the sabbatical came up with this incredible plan. We found out there were gobs of universities in the UK who wanted to do this. And we started out with West Midlands and it involved the University of Birmingham, the Warwick, Coventry and Aston and they would become the research centers. And then, we started this company the Lab UK Limited that would take the IP and everything was set up ready to go. Getting those four universities or five universities to talk to each other was quite an accomplishment in itself.

And then others want to get involved too, including Cambridge and Southampton and

others Nottingham, they all wanted to be part of this and we were going to start to grow it to where it became more a national thing. So there were seven million pounds sitting in the bank of EU money and matching money from these universities ready to go and the Cameron government came in and they killed all of the economic development centers, the regional economic development centers in the UK and there was no one to sign the check. They were done away with.

So what happened was throwing out the baby with the bathwater. None of it happened, even though the money was there, everything had been set up, just by a change in government. So that was a sad story.

But there's amazing capability in the UK and my old friends there that have been pioneering work for years and I really would have loved to have this opportunity to work with them in this way.

So what happened was that became – we know this transition from the military to the academy was the best move to make and as I started my lab, not only did we develop all these companies, spent off these companies, two are traded on NASDAQ, had a market cap now of about \$12 billion, but we had all these kids, including Alan Greylin, who was one of my students.

NICK ROSA: That has been also a guest of our podcast Field of View a few episodes ago. Amazing guy.

TOM FURNESS: Amazing guy and so, they're all these kids that are now in the business running the show that actually came through my lab and through the program at the University of Washington.

NICK ROSA: And right now, you have this new initiative that you started. Would you like to

talk about it a little bit more, this Virtual World Society?

TOM FURNESS: Yes, so while I was doing all this technology development and having a lot of fun doing that and, in the process, in about '93, it turns out the movie Lawnmower Man came out. And the director and the producer of Lawnmower Man contacted me to see if I would agree to be a technical advisor for their movie because it had to do with VR. And so, they sent me the script and I read the script and I said, oh gosh, oh no.

NICK ROSA: It was a pretty bad movie.

TOM FURNESS: This is going to be a dystopian movie – I mean there's a dystopian view of what VR is all about. And I knew what it would do. We already knew the power of it for education and for medicine and design and all these areas. And here, the first public view of VR was going to be all about sex and exploitation. And I thought, oh gosh, we got to do something about this. So I decided the best defense was a good offense, to be able to show people what good can come from this technology. And so, I organized the very first Virtual World Society in '93. And recruited bunches of kids because we were already doing a program out in schools with using the technology. And so, we had several hundred young people involved in this, had some funding, were a charity and then it dawned on me, you know, this is way too soon to be doing this because the technology is so expensive, it's really clunky. I mean you have to have 500 grand computer, graphics computer in your lab in order to make a decent virtual - real-time virtual world.

So I decided to put it on hold for a while, then I'd revisit it again several times until the timing was right. And once the Oculus Rift came out and when Palmer Luckey had his chance at building the first Oculus, it was clear to me that now is the time because what happened was it



showed the pent-up passion that was ready for it. We'd had this revolution and what was going on in smartphones and computation and telecommunications, the internet existed and in a big way. So the timing was right and it's not that anything was remarkable about Palmer and the Oculus. We were able to build those things you know 20 years ago, 30 years ago, it was just the technology had caught up with our vision.

And so, what happened was I decided let's do the Virtual World Society again. And so, we petitioned again the IRS. We became a charity in 1915, the part of - I'm sorry, 2015 and with the idea that we wanted to build society that would celebrate and develop the good side using VR for humanitarian applications because what we wanted to do was unlock minds and link hearts to use the technology to lift humanity. And that was the original mandate of the Virtual World Society.

And so, we would plan to have about a five-year startup period, which we've sort of ended now. We now have 1,300 members of the of the society or a little more and then we have partnerships with a number of organizations that have the same values, share the same values as we and working on establishing an alliance for good across these various organizations, non-profit and profit organizations. But that when we put our combined workforce together, we have 5,000 - a workforce of 5,000. And now, we're launching our project in stage two which we call Home Smart. And the idea of this Home Smart Project is that we want to build a center of learning in the home that basically celebrates and develops those superpowers we have as humans, that often get lost in institutional education.

Sir Ken Robinson talks about this a lot. And this idea of imagination, that is a human superpower, an ability to create and the ability to learn experientially. We're not minds to be filled, we're fires to be lit and that's what we're

trying to do and the place where that will happen is in the home. It's always been and now we can help with that. Schools are not keeping up with what's happening. They can't.

And furthermore, it really forces kids to sit in a chair throughout the day while they try to pour in stuff. And a lot of the kids are lost. Standardized tests are done that label the kids, this is a slow learner, this is a gifted learner, things like that and the kids start believing that and the teachers believe it. When, in fact, I've never seen a dumb kid. And we've proven over and over and over again when you put a child into VR and let them to build the virtual worlds, those kids that are failing, catch up with the smart kids and when you test them a year later, they're better.

So we have this incredible resource, natural resource of people and we're throwing away the superpowers. So that's what we're trying to do now. We have a two-year project, where we're identifying 100 homes around the world and these are homes not just with families, traditional families, but with individuals, but we're looking for diversity, economic diversity, ethnic diversity, with diversity in language around the world. And what we then do is take those families we've identified and we assign them a custom personal mentor to get to know them. They get to know what's going on in their family, in their home with their challenges, what things they like to do and then we set them up with a virtual reality center of learning with the technology, the latest technology, and access to bandwidth and start providing worlds for them, world experiences, worlds of wonder and adventures and flying a starship as a family to explore the universe and find out where there will be planets that would sustain life with astrobiology.

DANIEL COLAIANNI: What age bracket are you aiming for?



TOM FURNESS: Well, certainly we're looking for the whole family, ages very young to old. We don't want to put headsets onto really young people, but they can still work because there's not going to be just VR, there's going to be other technology, tablet computers, things like that where they're able to participate in this and augmented reality capability in the homes. And so, we also want to go all the way to the grandparents as well. They can all participate virtually in this.

We also want to look at accessibility and those grandparents who have - they're failing or they are on the other side of the country and they can't be there. And so, we do - we provide this technology, we provide the worlds both curated and worlds we develop, look at health and well-being and adventures and things like that and then what we do is we give them problems to solve. They are assigned a problem they need to work on as a family. It could be a local problem, could be associated with the United Nations 17 Sustainable Development Goals. They're assigned those problems to work on and they're taught how to build virtual roles themselves, associated with how you can educate and teach about those problems.

And then we combine the families. The families have an opportunity to communicate with each other and share experiences, what they've learned, the lessons learned from this. And then we have this repository of the worlds, this great library in the sky, where they all can draw from each other's worlds they build and add to those worlds. And then this culminates in a virtual campus where they're able to go and basically, be this center of learning where you go in whatever world you want to and based upon your interest and develop those interests.

And again, we're working with our partners in being able to accomplish this. So at the end of this two-year period, what we want to do is build a documentary, a documentary of their

stories, they tell the story, this is what happened to us over these two years when we had access to this whole new way of learning. And what will emerge from this is a whole new pedagogy of how we're going to learn the future because we're not going to learn the way we are now because the system we have now for education is really broken. And so, that's what we're after in this next stage. And then in later stages, we'll expand it. Ultimately, we want to become something like the National Geographic Society for the mind. I mean the National Geographic Society tries to bring this wonder of the outside world into us, right, provide an education. What we're trying to do is take the wonder that's inside of us out.

NICK ROSA: And make it public, available.

TOM FURNESS: To the world, make it public, yes.

NICK ROSA: I have a question and I don't know how we are with time, Daniel, if we have time for one last question.

DANIEL COLAIANNI: We're just coming towards the end.

NICK ROSA: Okay, so one last question. This is from our Extended Reality Global Lead, Daniel Gunter, that was very excited when I told him that we were going to have this interview and this podcast. That has been absolutely amazing. Thank you so much for taking us through this incredible trip across all your career and your vision of the future and what are you doing with the Virtual World Society. Daniel said that for someone like you, probably the most interesting thing to ask is if you're more or less excited about the future of VR right now when you started and what makes it so? Because you've been literally through the world story of XR since the inception until now. So do you think that is it more exciting right now to be in XR or was more exciting at the beginning when you started and why?



TOM FURNESS: Well, that's a great question. I think it's different certainly. At the beginning, we were just - every little step we made that made it better, you know, of course, was exciting. But now, all I can say is it's just joy seeing what people are able to do with it that I never thought of. And it's a voyage of discovery every day when I put on the headset or when I talk to people about what they've done. And they come to me and say, hey, check this out, see what you think. And it's sort of neat being in that position where they would like to show me. And I'm just I'm just blown away by it and it's an exciting time to be alive for me. And not that I - I mean when I put that headset on with my virtual super cockpit and thought, oh my goodness, what have we created here? I had no idea where it would lead, but I knew that was going to be pretty amazing, but it's even better than I ever thought and especially, the people. I am so impressed with the community, especially the women, the sisters are embracing this in a big way, heavily involved in it, leading it and they are the storytellers too. And I mean and it's ecumenical. One of the neat things about going into these virtual conferences is you don't really know what people really look like and it doesn't matter. You don't know what their color is. It doesn't matter because you grow to love them anyway and that's why this is probably one of the best training systems for our civilization that will bring us together. We'll really truly knit our hearts together in what we're trying to accomplish, not what we look like and whatever baggage comes with that based upon our -

So back to answering your question, I'm more excited today than I ever was in the past about what we can do with it, not just developing it. I was sort of in the push mode, right, pushing the technology. Now we're in an era of the pull side of what you can actually do with it.

I was at the Los Angeles VR Foundation a few years ago, they're doing these like the Academy Awards for XR and things like that and they awarded me the Lifetime Achievement Award in this, the so-called Produce Award. And it was just like the Academy Awards, they had the envelope that was opened and all this - well, not for me. I mean they did they just gave that to me. And after the event was over, these guys from Google that did the Tilt Brush, you know, they're the ones that that developed Tilt Brush, which is amazing, you know, where you go in and you do create 3D within 3D.

And they came up to me and surrounded me said, thank you, thank you, thank you for what you've done for giving us this medium to work with because it's changed our lives. And you know to feel that and to realize that you did something that was good, it's amazing. Let me go back to this business about not becoming an astronaut. I was really heartbroken by that, but what happened a few years ago, fairly recently, is that some of my students who were working for NASA said, hey, why don't you come down to NASA Houston? We want you to see the simulator that we built to train the astronauts to do the Hubble Space Telescope repair because they had to go up and fix that.

NICK ROSA: Yeah, that was a very difficult repair, yeah, yeah.

TOM FURNESS: And so, they built a VR simulation and said, we've used your technology to do this. And so, I went down there. I went to NASA Houston and they kidding me up with this, you know, with I was in the space suit and everything, with this VR projection and I went out on the simulated robot arm, into the shuttle bay and we're flying sort of upside down. So the earth was up here. And so, went out to there was the Hubble Space Telescope that been captured in the space shuttle bay and I went and did it. I took the electronics, the old electronics out and put the



new electronics in and this kind of thing and did the screws things up and get it fixed in NASA.

And as I was on my way back on the robot arm, I was looking around and I realized I did become an astronaut.

NICK ROSA: And this is the most wonderful way to close this podcast. I'm sorry. It's touching.

TOM FURNESS: And it was in the space that I had created to help those that are in the real space.

NICK ROSA: Thank you so much for sharing the story. Thank you so much really. This has been this has been wonderful, Tom. This is, oh my God, I would stay here for hours talking with you. You're a maeve of knowledge.

DANIEL COLAIANNI: This is the season finale for Season One. So it's been fantastic. I've learned so much in this space of time and it's interesting, when I first started in my journey, I thought I was pumped and invigorated and excited for this, but just after this conversation alone, I'm even 10 times more excited than I was before we started this podcast. And, yeah, it's just crazy.

TOM FURNESS: Well, that was a great question you asked. I mean I really am - you know, it's a great time to be alive. I mean it's just pure joy seeing what's happening, especially when the kids - you see the kids doing this and you rise, wow, this is a whole new chapter for them. They aren't intimidated by it all. I mean you know when we first did the working with the kids that when I arrived here in Seattle in '91, we did a project at the Pacific Science Center, which was our very first project, these are 9 to 14 year old kids, they were part of the summer academy. They would come a week, like summer camp at the Pacific Science Center and they could choose robotics or biology or ecology or VR and they talked us into it. The Pacific Science Center talked us into it. We

thought, oh gosh, these kids will never get this. This is too far out. We were wrong. Twenty minutes and they were trying to figure out what kind of world they were going to build and in a week they did it. And these are incredible worlds and they didn't know each other, but they sat down and said, we have a chance to build a new world, what will it be?

So we just need to get out of the way. We need to give them what they need and then get out of the way and let them take it from here.

NICK ROSA: Go and building worlds.

DANIEL COLAIANNI: What's that one piece of advice then that you would give to that aspiring astronaut, I guess, way back then when you started your journey, what would that be?

TOM FURNESS: Well, you know, again, it's not about the destination. It's really about the journey. And this sort of eternal presence and just have fun along the way, whatever it is, because it's all going to work out. I thought I had had to plot this whole thing out of my mind and decided that having fun right now is going to be okay and that it's going to lead somewhere. And I see this with the kids today, that there's too much pressure I think we put on children to go out there and get a job and get a career and things like that when, in fact, they need a chance to explore. And you do that, you have to take jobs that you find out I don't want to go in that direction, but yeah, it's about the trip.

I remember the closing words of Star Trek with Captain Kirk. I don't know if you remember that episode where he was dying, right, actually finally dying, and he was there and his last words were it was fun.

NICK ROSA: Thank you. Thank you so much, Tom. This has been amazing, amazing. It's a privilege talking to you and I hope that we're



going have a chance to do it more often in the future.

TOM FURNESS: I do too and you do a great work getting the word out, you chronicled this whole new thing and this is one of the ways, back to answering the question how does it get out there what you're doing? And so, let me know how I can help continuing with that, including I love to follow with the Accenture connection and see how especially as we're talking about – well, two areas, one, not only the R&D area which is an area that's exciting, of course. But also, the Virtual World Society and this Home Smart Project and things like that, which we will learn a lot. Nobody knows what's going to happen in the home with this technology, nobody knows. And this is a big experiment. I call it an experiment because there'll be emergence of things that we never think of.

DANIEL COLAIANNI: That's great. Well, look, thanks everyone for joining us on this very special journey. As I mentioned, this is the end of Season One, but there will be bonus content from this episode as well that you'll be able to watch separately and then stay tuned for Season Two where we'll be exploring the world of XR in even more detail kind of moving forward.

As always, you can catch this podcast on YouTube to watch us in person and kind of see our beautiful faces or, you know, if you just want to listen in the car or maybe at the end of a long day, then you can catch us on Apple Music or Apple Podcast, Spotify, Google Podcast or all the locations where you'd normally get your podcast as well.

NICK ROSA: And please don't forget to subscribe and like if you like this video. Thank you so much, Tom, and thanks everybody for tuning in.

TOM FURNESS: Thank you, guys. It's been fun.

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