**Craig:** Hi, I'm Craig Smith and this is Eye on AI.

This week, I have fascinating conversation with Gavin Miller, head of research at Adobe, visual creativity software company. We spoke about how Adobe is using AI to accelerate the creation and editing of images and video, about the how AI will impact the visual arts, about guarding against misses of manipulated visual media and about Gavin's private pursuit building AI enabled robot snakes and spiders. I hope you find the conversation as inspiring as I did.

Okay, Gavin, it's wonderful to meet you. I'd like to start by having you us your background, particularly in AI and AI research, how you got to Adobe, and then we can talk about the things that you're doing with Adobe and how the future of creativity looks now AI is becoming part of the creative process.

**Gavin:** My original background was realistic computer graphics. I worked at a startup company in Canada after my PhD at Cambridge, and then joined Apple's advanced technology group in the late 1980s. And was there till the mid to late nineties, worked for

**Gavin:** an incubator for Paul Allen called interval, where we did media research, including VR, and then joined Adobe in 2000 working on a interactive, 3d virtual worlds project. And then in about 2005, as Adobe's advanced technology group became Adobe research, I joined and initially focused on accelerating technology with GPUs, which were in their early days at that time. And then as I became head of Adobe research, AI has just become an indispensable part of most of the projects we do, particularly things around audio and video, but increasingly natural language processing and other things. So my role is really managing world-class research in this space.

**Gavin:** And then I also have hobbies where I build agents and other things just to really try to understand the technology, both from the visual side, as well as the natural language processing side, so that I can engage with my staff and see the potential of these technologies as they become relevant to Adobe products and future ideas as well.

**Craig:** I've talked to a lot of AI researchers that came out of computer graphics particularly gaming, because there's so much potential for AI in that world. Could you give me an overview of how Adobe uses AI?

**Gavin:** One of the first use cases is identifying characteristics of images and being able to generate first of all, auto tagging and then ultimately auto captioning of assets. This then enabled much richer search of large content collections.

**Gavin:** We have stock photography collections, but we also have portfolios online where artists share their work. And so there was an explosion of content. People wanted to be able to navigate and find fairly fine grain variations of things. And then increasingly we realized that language alone and particularly individual words alone, wasn't sufficient to capture the nuances of the content. And so we worked on similarity search, which has abstract geometrical properties of the images as well as the more recognizable categories. And so then we could search both by example as well as by keyword.

**Gavin:** So search was really the first frontier. There was this virtuous cycle between the amount of data that was available for training, but also the need to navigate all of that data by the user. And so the abundance of data, both created a problem and then AI with the data presented a solution for how to make the most of those large collections of assets.

**Gavin:** So that was the first stage. The second stage was really looking at some of our classic tools like photoshop and saying, we were doing our best with what you might call classical algorithms things based on some abstract idea of energy or some optimization that you might be doing. And the problem with those algorithms was they only went so far.

**Gavin:** They only knew about the image they were looking at. And so you'd be looking for things like boundaries in images, to be able to do a segmentation. And some images are basically ambiguous and human beings bring experience of the world to these tasks. Whereas the algorithms, as they were then set up only had experience of some abstract mathematical idea, plus the image in front of them.

**Gavin:** So the second generation of AI adoption was really taking our classic tools like segmentation selection and so on and retraining them with examples as neural nets. And we found that fairly rapidly, they could eclipse the handcrafted algorithms of the previous generation of software. And so this gave us the confidence to double down on research.

**Gavin:** So reinventing the classic things like hole filling as well as selection was the next step. The advantage of this was not only did it do a better job, but you could do with one click previously took a whole bunch of strokes from the user and in some cases, With something we call select subject, you could literally recognize what is the foreground object in this image and automatically segment it from the background with no clicks from the user. Another example of that would be sky segmentation, where you might just automatically recognize the region of an image, which is the sky. And then you could automatically swap that for other images of the sky that matched geometrically.

**Gavin:** The sort of reinvention of the algorithms to the point where they were automatic then meant we could do compound features like sky replace, where we put a bunch of these together and added some conventional imaging operations in the mix. And we could suddenly do a whole new capability, something that could have been done in maybe five or 10 minutes before in Photoshop now happens in less than a second.

**Gavin:** And that meant you could them see the final production quality, but with a whole bunch of variations. And so you spend more time sort of making artistic choices rather than the mechanics of getting those productions done.

**Craig:** is that available on all levels of Photoshop or is that a professional level?

**Gavin:** It's an interesting question. Sometimes the AI feature is one that's better suited to consumers because it's a transformation of ease of use, but maybe isn't quite perfect yet. So sometimes we go from the mass market to the professional market. Sometimes it starts in the professional tool. And then as we make the algorithms more automatic, we democratize them to the consumer facing versions of Photoshop. So it works both ways. It's really an attempt to democratize things that were previously tedious and hard to learn how to do to a much broader audience so they can focus on the creative outcome that they want.

**Craig:** When I'm using Photoshop, for example, are those algorithms embedded in the product on my device or is it communicating back to a central server?

**Gavin:** Some of it's on device and some of it's going back to a central server and it's usually determined by two things, the amount of compute you need, and then also the size of the model.

**Gavin:** We recently released some features called neural filters, which included a number of fairly complicated neural nets, some of which can be downloaded and run locally and some of which would run in the cloud.

**Craig:** And what are those neural nets doing?

**Gavin:** One of them is figuring out given a black and white image, how to make a color image and.

**Gavin:** That's obviously ambiguous. There is some valid choices , it could be green or blue. So you might have the user give you a single point on the shirt to say what color they want it to be. And then the rest of it is inferred of automatically by the algorithm. And then the smart portrait is letting you take an image of somebody's face.

**Gavin:** And then edit the expression, the orientation of the head, you can rotate it slightly from left to right. you can change where the person's looking and you can even change their age. Not necessarily biologically predictive, but something that's reasonably plausible as that older or younger version of the same image.

**Gavin:** Those ones are in the pro version at the moment.

**Craig:** And then you mentioned VR and the project that you were involved in early on.

**Gavin:** It was very early days. We were thinking that the internet was about to go 3D at one of those predictions that's been for a long time.

**Gavin:** VR has got tied up in the sort of goggles and devices evolution. But I think today we have a project called Aero, which is looking at doing augmented reality on the phone, where you look through the lens of the camera, and then you can see additional objects superimposed on top, based on the context, which could be static objects so they could be signage or animated characters. So I like to say that you dream in hardware and then ship in software. And I think at the moment, examples are a good representation of that strategy

**Craig:** and the Aero project. Can you describe what that is or will be

**Gavin:** it's a project in which you can annotate a physical space with virtual assets. And then I have them appear based on some trigger in the environment, whether it's location or clicking on a poster or something like that. And then it springs to life in 3D

**Craig:** and would, that require goggles

**Gavin:** no, it runs on the phone today.

**Gavin:** But getting back to our professional tools. I think I have some other examples of things that maybe will help explain how AI can be helpful. So on the one hand, as I mentioned, these tools are great for doing what were previously relatively tedious tasks more automatically, but then as things go digital, they introduce more tedious tasks to do for productions.

**Gavin:** A good example of that is we all have different greens and different orientations. And if you're making a video of what works well, Orientation doesn't work well for another. And this idea goes all the way back to, movies with wide screens and in the day, narrow screen televisions. And now we have wide screen televisions and narrow screen phones.

**Gavin:** And so we had a project called auto reframe, which would use a neural net to look at a video, figure out what was the important or what we call salient part the video, and then we'd automatically pan across the video to give you say a tall narrow version of the same video that you produced in widescreen format. And so we're learning by example from great cinematographers and others, to then do that as a starting point for people as a convenience feature, if they are, say designing a video that they want to distribute on the web on TV and also on phones for people.

**Craig:** That's fascinating. So you would shoot a video and then

**Gavin:** you'd shoot a video in probably the best high resolution format you could. And probably you do that in landscape mode for display on, say a 4k television. But then the algorithm can automatically come up with a phone friendly portrait format.

**Gavin:** And again, there's no perfect way to do this. You really have to look at the content to do it properly. And the great thing about neural nets is given lots of examples, they can come up with a pretty good starting point for a decent way to reframe the image so that you may not need to do anything to make it consumable.

**Gavin:** Or you can take it as the starting point for them and tweaking. If you want to adjust, making sure it doesn't touch the edge of the frame or there's something particular in the background that you're interested in.

**Gavin:** We have projects where we look at automatically relighting, say an object to match a background.

**Gavin:** So if you want to do that for a still image, you can use Adobe Dimension, which is a product where you bring in a background plate or an image, and then you can have 3D foreground objects and an AI algorithm estimates the lighting and the background from looking at the image and then can apply that to the rendered 3d object.

**Gavin:** So increasingly we're very interested in understanding a scene, not just in terms of it's two dimensional pixels, but its three-dimensional structure and also the lighting of materials that you're seeing so that you can then blend in new elements to match. In the old days, when you combine two photographs together, they'd look like a collage.

**Gavin:** They clearly been modified, taken from different shots and you had to be very careful taking the photograph that the lighting would match. Increasingly we're able to modify lighting in post-production rather than at the time.

**Craig:** Yeah. I presume that also then can adjust resolution. Because oftentimes two photos in different lighting have different resolutions.

**Gavin:** Right. It's one of the interesting things about neural nets is that you can actually use them to up those images in ways that my college professors would have told me was impossible.

**Gavin:** So there's something called sampling theory, which says, if you have so many pixels, then there's only so much signal and if you zoom in, it'll get blurry. But, with neural nets, you can have shown them low res and high res images of a variety of subjects. And they learn to generalize what will become a crisp edge or what will become a soft transition. And so you have a lot more flexibility now about both denoising images, if they were shot in low light, and also being able to zoom in so that you can take a portion of an image for full screen use. So that's an exciting thing.

**Gavin:** It may be a very hidden feature, like just a resizing option in Photoshop but under the hood, it's doing a lot of AI. So quite a lot of the AI we do is almost invisible, but not quite. It's enabling something that wouldn't have been possible before, but once you have it, it just seems very natural.

**Gavin:** People don't even think that they using AI for something like that.

**Craig:** Are you guys doing anything with GANs?

**Gavin:** Absolutely. Yeah. So I talked about auto labeling things and then being able to modify them or hallucinate extra channels, like color or depth. But again is something where you can give it to an abstract description of something and it can literally generate an image from a domain that has been trained in, and the neural filter that I talked about, the smart portrait is an example of a GAN, where you give it a photograph. As a starting point. It then maps that to a n-dimensional vector in feature space. And then by nudging, that vector is how you make the edits to appearance or age or gaze direction. So it's a really exciting area and we're focusing on people first, partly because it's wonderful use case of GANs, and also people are very picky about imperfections and images of people. And we feel that if we can do that for realistic humans, then we can apply it to many other domains. We have other work related to landscapes and so on in the lab. So it's not just restricted to people, but that is the first one.

**Craig:** Let me back out a little bit and just put all of this in the context of the history of neural nets, because this really is tracking the development of neural nets, if I'm not mistaken. So there was the validation in 2012 with Geoff Hinton's group and AlexNet. And from there, there was just an explosion of research. And following that applications of these different strains of deep learning. And now you have GANs and you have the transformer algorithms and the large language models like GPT-3

**Gavin:** and we also have contributed to that literature and have some neural nets we helped to amend like something called a swapping autoencoder where you take the structure from one image and the texture from another one, recombine them in really exciting ways that looks realistic.

**Gavin:** It's holding the promise of doing things at high resolution. Some of our recent results, a very high resolution. So some of the challenges with GANs is just getting the resolution up. It's been possible with faces, but with other topics it has proven more challenging with reasonable amounts of data.

**Gavin:** But this other algorithm gives us sort of photographic quality results and this sort of mix and match capability. And one of the uses is style transfer. But you can also use it for day to night or winter to summer. Other kind of magical things that would previously require somebody to repaint the image.

**Craig:** A lot of this we're talking about still imagery. A lot of the research now is focusing on video. Do you have plans to apply this stuff increasingly to video.

**Gavin:** We, we already have, so that's a great point. I focused on Photoshop because it's a nice use case of these different networks, but video is even more important in that there's so much work to do with video because each frame is different that some of the more manual methods that might be acceptable for a still just don't scale to videos, unless you have a huge production budget. So we've been looking very hard at how to dramatically accelerate things that high-end films have done for a while, but that say a web video might want to be able to do in the future.

**Gavin:** So a couple of examples of that one is content aware fill for video. So this is where you just have a video and you take a street scene and you want the street, but you don't want the people walking by. And it's a way to rapidly annotate and then remove the people from the background. And then using multiple frames together basically makes up either makes up or copies in from other frames the missing portions that were left by the holes where you removed a distracting object. And that one won a number of awards at NAB and elsewhere, and it is dramatically accelerating video production for people. And then the second one which is related is called Fast Mask, which again, won some awards, which is the ability to segment out a moving subject.

**Gavin:** So just as in Photoshop, you might say select a foreground object and maybe want to make the background black and white. So you can do that in one frame of a still in a video. And then it propagates through to the other frames in the same tape. So what used to take hours and hours happens in a few seconds and you have some wonderful demos of that, where you can then once you've segmented things insert decorative confetti flying or a graphical logo.

**Craig:** I've talked to a lot of people about training data for neural nets. And one of the challenges with supervised learning is labeling video. Is there an application of that to the annotation process or do you make that available as a annotation?

**Gavin:** That's interesting. No we do our own annotation to train our models, but we haven't been making, say a tracker available for annotation for third party datasets,

**Craig:** just looking into the future. And we'll talk about the nature of AI in creativity generally.

**Craig:** but another thing that I'm involved in is AI for education and AI tutors. Right now they're text based, but the ambition would be to have an avatar, a realistic avatar that can communicate with the students. And then Samsung came out with this Neon AI powered avatar that takes an enormous amount of compute to run in real time.

**Craig:** But is Adobe looking in that direction at all?

**Gavin:** It's a really interesting question.

**Gavin:** In a way I would have agreed with you more two or three years ago than I do now. I think we have our own educational challenge, which is educating our users to use our products. So we put a lot of work into online help and so on.

**Gavin:** And increasingly we are looking at what the user is actually doing with our products and then using that to suggest reference material for ideas of what to do next or useful help material if they're stuck or they need an idea, or they want to understand something better.

**Gavin:** So in a way we used to think that it would be an embodied social agent that would have a dialogue with you.

**Gavin:** And the challenge with that is you really need almost human level AI, and you also need you need of omniscient agents that know all about everything.

**Gavin:** Whereas if you can have a helpful panel, that's making suggestions based on the context you're in, it can be actually less cognitive load on the person doing the task, but just as helpful.

**Gavin:** So I think there are ways in which given the current state of NLP, it's somewhat easier to find relevant and helpful material to suggest, in short, than it is necessarily to have a fully cognizant dialogue with an agent. It's a dream we're all excited about. And my robots at home, I try to teach them how to have simple conversations with me about themselves and what they see and everything.

**Gavin:** But the truth is the state of the art, at least for now is better for this other kind of help which is also doing. Natural language processing , but in a way that might seem more conventional, a bit less sociable than a pop up agent with a smiling face.

**Craig:** I was actually asking more, whether you're going in the direction of allowing users to create video avatars that could operate in real time as a feature. Are you familiar with Samsung's neon?

**Gavin:** Yes, I am.

**Gavin:** At the moment, the imaging work around realistic looking people is focusing on stills.

**Gavin:** We do have interesting work we're doing on a directable characters for Aero, the AR project that I told you about, and there its probably focused more about walking around and doing tasks then having a face-to-face conversations at the moment, but it certainly an area that we'd like to go to in the future.

**Craig:** How do you see AI and creativity developing together? Certainly until now it's being used as a time-saver it's not really being used in leading creativity, but it certainly could I mean, can you talk a little bit about that?

**Gavin:** I think you'd have to look at the neural filters to say, if you feel the same way.

**Gavin:** The GAN's in particular and also stylization by example means that you can rapidly take an image and abstract elements of one image and apply it to another, in a way that is a creative exploration. And if somebody had been doing this by hand 20 years ago, you might have called it creative, but now it seems more like part of the tool.

**Gavin:** The long-term vision I think is to have what we call the visual imagination machine, where you start having a dialogue about something that you wanted to learn to depict back to you, and you give it maybe snippets of dialogue, or elements of images and direct manipulation. And. It can hone in on a creative idea that as you see it interpret what you're saying, you may have a further idea.

**Gavin:** And so I think will be this very tight coupling between what the generative models display and how you then augment them with further interaction. And I think it'll be a combination of brushing or painting where that makes sense.

**Gavin:** There's something called semantic paint, where you paint an idea. I want the river in this region or a mountain or trees over here.

**Gavin:** And then the algorithm generates the detailed photo- realistic coherent lighting version of that high-level description. And then there may be points at which you want to go in and click the eyebrow and nudge it by a 10th of an inch. And the face responds naturally to that adjustment. So I think you'll zoom out to the high level concept of what you want to do all the way into the fine details of how you want the final presentation of that idea to be expressed.

**Gavin:** And that to me is almost a new medium.

**Gavin:** You're not directly manipulating the pixels anymore. You're really interacting at the level of an idea. And to some degree, it's like an art director with a great technical artist working for them, but dramatically accelerated.

**Gavin:** And that dialogue between the two and even the art director is not quite knowing what they want, but when they see it, it inspires another idea. I think that's where we see the future of creativity going. So it doesn't take the creative out of the loop, if anything, it accelerates the loop and less than mixed, more, many more ideas and find a great one.

**Gavin:** And then once they have it to polish it to what they view as their sense of perfection.

**Craig:** Of course, none of us can imagine how this is going to affect creativity in the future, but what we're talking about is a democratization of a lot of these processes, which previously required very high level human skill.

**Gavin:** Correct.

**Craig:** And now the human directs the AI to do these things, but it's at this point, still a human with a high level of technical expertise.

**Craig:** But as the interfaces become increasingly abstracted, it'll be available to a broader and broader swath of humanity, but when things become too common, they lose their value. And what made me think this the other day is, I have a couple of the style transfer apps on my phone and I took a picture of myself and put it through a couple of processes and I thought it looked very cool and I put it on my family WhatsApp channel so my kids could see it.

**Craig:** And my older brother's reaction was wow, that is so cool. My, my younger son's reaction was, oh yeah, you put it through a filter. Or I don't remember it. Yeah. To him was just like, yeah. Okay. You punched a few buttons and it made it look different. That's very cool dad. So

**Gavin:** It's what we call the one trick pony problem, that if it's too pre cooked as a technique, then it rapidly loses interest as it becomes commonly known.

**Gavin:** I think this will have two effects.

**Gavin:** Say you're, rather than using an algorithm, you were using an example image where you love the style of it. And you were applying that style to your own image.

**Gavin:** That other image came from somewhere. It could have been hand done painting using something like Adobe fresco, which simulates oil paint and watercolor very precisely and people could spend hours making a beautiful thing, which is a brand new idea. And then lots of people might copy it either by sharing the image directly today or by sharing the style of it tomorrow with their own content.

**Gavin:** So I think it will accelerate the fashion cycle if you like, if new ideas and the hunger for new ideas and the rates at which old ideas become, 'oh, that was, April 20, 2022 and what have you done lately?'

**Gavin:** But I also think the ability to invent radically new different things will continue to accelerate.

**Gavin:** And so it's like the early days of photography, the fact that you can take an image at all and reproduce it was amazing because it used to be that an oil painting was very expensive and rare and only very rich people could afford them. And then it became a commodity and then a fine art of really original photographs and really original points of view or subject matters came up as the sort of fine art portion of photography as well as the family snapshots.

**Gavin:** So I think the same will happen with AI, where there will be cheap and cheerful videos showing the story that somebody wants to tell about their afternoon. And then there'll be really memorable things which are seen as a really original use that this emerging medium and maybe groundbreaking, even if it's then subsequently highly copied by others.

**Craig:** Do you envision the day where the AI , or agents, AI agents are doing more of the ideation as AI systems get closer to human level intelligence?

**Gavin:** It's an interesting thought. I think the real thing is you need empathy for what will resonate with people. And I think that's still a great human skill.

**Gavin:** There are pop singers who generate random phrases on their phones to inspire lyrics, right?

**Gavin:** So even today, without necessarily understanding the meaning of the words, there are ways in which computers can maybe make jarring juxtapositions, which might inspire a creator. I think with things like the advanced language models, maybe you'll generate lots of bad poetry and occasionally get lucky and hit on something that has a meaning that resonates in a way that the AI didn't understand, but a person recognized.

**Gavin:** So there may be some discoveries of computer made things that seem profound. And then who's to say, 50 years from now How much insight the algorithms will have. People focus on the systems, but really in this closed loop of feedback and adjustment to what's made based on audience response, you're really harvesting the wisdom of the crowd.

**Gavin:** And so one of the interesting things about AI is

**Gavin:** it's another medium in which a community can have a dialogue with itself, Reporting and creative writing and other things, but also the idea that you're, co-training this expression of group wisdom or group tastes is really an interesting model.

**Gavin:** So at that point, you're not really saying the algorithm is being truly creative, but the interaction between the algorithm and the community is being very creative.

**Craig:** You made a casual reference to conversational robots in your home. I'd like to hear about,

**Gavin:** It's a hobby, but I've been building robots for 20 or 30 years that are biologically inspired. Originally I was very interested in snakes and now I have robot spiders.

**Gavin:** They are about, about two feet long

**Gavin:** And then adding natural language models to it, to really have a knowledge base of itself so that it can have a reasonable sense of what its parts are. And so on. I'm trying to get to the point where you can have a dialogue with it about the nature of being self-aware.

**Gavin:** It should be able to use its camera to look at its foot and recognize it as part of itself, recognize itself in the mirror, be able to understand the consequences of its actions, so do planning and so on. So it's a very humbling goal. It can fail in ways that surprise

**Gavin:** me and, because I, I like to do creative writing, when it messes up the grammar, I feel particularly mortified. But it's also a way for me to try to synthesize things together

**Gavin:** to make me stay current with what my staff are doing at work, and understand what it takes in practice to get these things to work because , as a vice-president, I tend to spend a lot of time in meetings and presenting ideas rather than building them directly.

**Gavin:** So I like to keep my hand in at home just to stay credible and also see some emerging potential things to get competent at.

**Gavin:** One of the things that surprised me about my job in the last few years has been the ever-growing societal relevance of what we do. And in particular concerns about ethics and authenticity of media.

**Gavin:** And so I'm involved in several of the efforts at Adobe to try to have a thoughtful response to this.

**Gavin:** Adobe loves to create tools that enable the willing suspension of disbelief, but sometimes things may be used to deceive , deep fakes as one example. And so we have two thrusts to the way we're thinking about being a responsible company.

**Gavin:** One is around AI ethical guidelines for how we build our models and in particular, making sure that the models to the degree, to which we can avoid it, don't have bias in them. So they should work equally well for every type of person, every age, background, ethnicity, and so on. And that takes an active process to ensure it doesn't just happen by default.

**Gavin:** Collections of images tend to have built in biases based on where they came from. And so we have an active process to look at emerging features to make sure that they live up to the guidelines that we're formulating around how they should work well for people and so on. And then the other side of the ethics is given this very powerful technology to transform and modify images, in the case where an image is trying to be used for a historical record of truth. Is there anything we could do to make that more plausible so that you can't just say it, it could be fake, right?

**Gavin:** And the challenge is that there are algorithms to test for whether an image has been tampered with, and we've developed some ourselves, but it's a constant race between the people doing the alterations and the people trying to detect.

**Gavin:** So in addition to that effort, which is worthy but not completely reliable, we have something called the content authenticity initiative where we're formulating ways that artists, as they create their work with our tools can register them in the form that they are so that they can be snapshotted it in time.

**Gavin:** And if they want to do reasonable adjustments to their material, say a journalist wants to brighten an image, which is a modification, but not one that fundamentally changes the meaning of the content. They can keep a trail of what edits were done to show that we didn't delete people or anything. We just made it more approachable by adding a caption or something else.

**Gavin:** So that's a project that we're doing in collaboration with other companies. And we think that this combination of the two work. We now have over 200 partners for the content authenticity initiative, including New York times and Twitter.

**Craig:** There would be standards then

**Gavin:** yes, there is a standards group that were helping to drive as well around this.

**Gavin:** So it would be standard metadata that would then be held securely and a distributed ledger to, be able to not have a single point of failure where someone could edit the record and change the history of it.

**Gavin:** That's the idea.

**Gavin:** And then this annotation would be available to people looking at images on a news site, for instance, and then be able to make their own judgment about whether they trust the asset based on the reputation of where it came from, but also the edit history of what happened to it along the way.

**Gavin:** If people are doing something where they're not even hoping that it will pretend to be true, right? Like you're doing special effects for movies you wouldn't necessarily do this. But if you are, say a journalist or a citizen journalist, you might turn this feature on because you want it to be registered before somebody else copies your image and modifies it and posts their own version of it. And you then have a historical record of it having existed in your ecosystem.

**Craig:** Would this be involving a blockchain ledger or anything like that?

**Gavin:** It's one of the ways in which you might do at distributed trust system, but that's still a matter of design, but you want to do it in energy efficient way and so on,

**Craig:** We talked about the generative work for stills. Does Adobe, allow deep fake trainings and that sort of thing? Do you have that feature because there are a lot of legitimate uses that are quite interesting.

**Gavin:** Do you mean like changing the appearance of the face in a photograph?

**Craig:** Yeah. By either putting synthetic face on a person so that they're anonymous, or licensing celebrity faces.

**Gavin:** We have the ability to edit aspects of faces using neural filters.

**Gavin:** Why not currently doing identity swaps. Clearly we have the technology for that, but we're obviously thinking through what that would mean in terms of how it would be used.

**Gavin:** But you can navigate designs of faces , for some use cases like coming up with a marketing persona for a product where you don't want to use a real person, but you just want a person that somehow represents your brand would be one possible use of such technology.

**Gavin:** More in the still space at the moment than in video.

**Gavin:** One of the questions I ask my stuff was well, the future look more like star Trek or Harry Potter . Was it going to look very technical with glowing screens or would it have things that look more like natural objects that had magical properties that would change as you see in the sort of special effects for those movies?

**Gavin:** And I think even though the screens and the technology that we have a much more star Trek, I think some of the transformations made possible by AI really are in the magical domain where you can make changes spontaneously that would have seemed like magic a few years ago.

**Gavin:** And so I understand that people have concerns about how this technology may be misused. We're doing our best to provide mechanisms for those fears to be addressed. But I don't want people to lose sight of the potential magic of having an image in your head of a story you want to tell, and rather like a movie director with a hundred million dollars today in the future, you should be able to come up with a really compelling looking visual, whether it's impressionistic or realistic, that tells the story in the magical way and the magical appearance that you had in mind. And we're trying to build tools that will let you do that and provided it is used transparently, I think people will find it really inspiring for their own creativity and what it empowers them to do as well as enjoying the creations of others.

**Gavin:** We're really trying to democratize the high end of film production down to the point where every aspiring creator could have that quality of outcome. And I think that's a wonderful goal for the world and also for Adobe.

**Gavin:** The one other topic that might be worth spending a couple of minutes on is just what I call renaissance 2.0, so the idea that in the Renaissance, they rediscovered classical art and they formulated rules of perspective that could then be shared almost algorithmically with each other, for doing images of buildings. But then other things like lighting and people had to be done basically by learning from example in a workshop, as an apprentice and so on.

**Gavin:** That had its peak in the 19th century with hyper-realistic oil painting. And then in a way the world stepped away from that with the invention of photography. With AI, it's really coming back and we have ways to simulate and create clothing and drapery and things that, would have happily been on display in the Uffizi gallery back in the Renaissance, and yet democratized to a large number of people, rather than limited to a few brilliant people as it was.

**Gavin:** So I really think it's an opportunity to rediscover some of the treasures embedded in classical art and re-express them in algorithms, whether it's in terms of skies or drapery or faces or greenery landscapes. And by distilling it into algorithms and models, we can then give it to everyone to express their interests and the network effect of expertise adding on top of expertise, rather than each individual having to learn everything from scratch as was the case with classical art, I think is why we're seeing such an acceleration of progress right now.

**Craig:** That's it for this week's podcast. I want to thank Gavin for his time. As usual, you can find a transcript of this episode on our website, eye-on.ai. You can also check out Gavin's robots at doctorgavin.com or snakerobots.com. Remember, the Singularity may not be near, but AI is about to change your world. So, pay attention.