Speaker 1: This is ACM ByteCast, a podcast series from the Association for Computing Machinery, the world's largest education and scientific computing society. We talk to researchers, practitioners, and innovators who are at the intersection of computing research and practice. They share their experiences, the lessons they've learned, and their own visions for the future of computing. I am your host, Bruke Kifle.

Bruke Kifle: Our next guest is an innovator, futurist, and artist with an interesting love for space dinosaurs who believes in bringing crazy ideas and moonshot thinking to create future innovation. Pat Pataranutaporn is a technologist and researcher at the Massachusetts Institute of Technology, also known as MIT, where he explores the intersection of synthetic virtual humans and synthetic biology, specifically at the interface between biological and digital systems.

He's currently a PhD candidate at the Fluid Interfaces Research Group at the MIT Media Lab and a KPTG fellow where he works with his collaborator such as NASA, IBM, UCSB, Stanford, and Harvard amongst many others to examine the future of human computer integration. His interdisciplinary research has been published and recognized worldwide and in addition to scientific contributions, Pat's artistic projects have been featured at many museums and exhibits around the world. Pat believes in bringing crazy ideas and moonshot thinking to create future innovation. Pat, welcome to ByteCast.

Pat Pataranutap...: Thank you for having me, hello.

Bruke Kifle: I would love to start off with a question that I ask most of my guests. Can you tell us a bit about your personal background and maybe a couple of key experiences or inflection points, as I like to call them, within your personal and academic journey that have led you into the field of computing, but also your field of study today?

Pat Pataranutap...: That's a great question. So as you may have mentioned, I'm a PhD student now at MIT Media Lab, and one of the reason I'm here is that when I was in high school ... and maybe we should go back a little bit further than that. I grew up really liking dinosaur, dinosaur was a source of inspiration for me. Like many people, I think dinosaur has been the reason why I study Science. Dinosaurs are all extinct, but they're very cool and have inspired many of us to think about what is out there, what is in the past, and what could be in the future? I grew up really liking dinosaur and then I watched many science fiction as a kid, many science fiction involve dinosaur like Jurassic Park or there's this anime cartoon called Doraemon, which is about a robot cat that help a child with different tasks.

And in that cartoon, the Doraemon robot will bring a different gadget like a car machine, take a trip to the past and see dinosaurs, and also other gadgets that help improve human life. And what was really interesting to me is that, people often associate dinosaur with the past, but dinosaur, to me, is also a

representation of the future with new technological innovation, bring back the dinosaur, but it could also be dangerous as well. So it's like a cautionary tale of how to usually use technology for the positive application. After that, I think that science fiction or doing something very cool with science technology would be something that I would love to do in the future.

But I often think that it's only in the cartoon or in science fiction until I watch the TED Talk of my current professor at MIT Media Lab Professor Pattie Maes, she show in one of the most famous TED Talk ever, that you can bring technology to the human body and create a real cyborg. And that, to me, was the moment that changed my life. I said that, there are people that are actually doing really cool scientific work but also very fun and very futuristic, something that I've only seen in science fiction until that point. And that's how I discovered a few of human computer interaction, and I think at that time I was in the last year of high school and I reached out to Pattie, from out of my Gmail, I wrote an email to Professor Pattie Maes of MIT Media Lab.

At that time, I did not know that MIT professors are the busiest people on earth. And I reached out to her and she was so kind to write me back, and I sent her a DIY prototype that I made in my high school based on the research that she presented into her TED talk and that's how we know each other. And after that, I stayed in touch with Pattie and then applied to her research lab and become part of her research group. And now I'm continuing that work on human computer interaction, wearable technology, things that are very futuristic but also grounded in real scientific research and try to see if we can really use the technology to improve human life. So to summarize it, it started off as a science fiction, not as scientific exploration at all, it started off as a science fiction obsession, a childhood inspiration cartoon, and then that lead to real research at MIT. So that's my journey.

Bruke Kifle: What an amazing life experience. I think many of us in tech, or at least I'll speak for myself, I was also very much interested in the field of science and technology, primarily because of growing up watching science fiction and being fascinated by the potential of what could be. So it seems like that passion and excitement ultimately led to a real life career, so it's very exciting to see how that has ultimately manifested in the trajectory that you've chosen.

One thing I want to learn a bit more about, you seem to be a very hands-on individual, I've seen some of your creations. So what ultimately led you to decide that a career in research or at least going down the path of graduate school was the right decision for you as opposed to maybe exploring some of your scientific passions as an entrepreneur or as a maker? Why did you feel that graduate school was the right path for advancing your career? I think your advisor, as you mentioned, motivated a lot of your interests with that TED talk, so I'm sure that's a big piece, but I'm curious if maybe there are other motivators for your decision?

Pat Pataranutap...: Yes. My mentor, definitely is my intellectual hero is one of the reasons that I pursue graduate school. But I think one thing that I really appreciate about doing research here at MIT Media Lab, is that we get to imagine the future. When doing my undergrad, I explored a startup career and think about what does it mean to be a researcher and creating a startup, and I did realize that you need to focus on solving immediate problem and that's really cool and there are a lot of people doing that. But for me, I feel like my strength is to be more imaginative and think in the longer term, explore new possibility that haven't been explored before. And I think that is a lot of fun and a lot of impact in that.

One of the reason that the Media Lab is a really cool place is that, we get to work in a very interesting and emerging field, sometimes we don't even have a name for that category. I think recently, we started to call ourself human AI interaction researcher, but that's really new compared to human computer interaction. So the view is self-evolving and we bring more and more discipline or more and more diverse background of people to work in our team and that expands our thinking in terms of what that area should be like. And in the Media Lab, we always say that we connect art, science, design, engineering together, and that usually not just lead to new answer, but also new question that we never asked before. And for me, that's really exciting, that's when the research's not just generating answer but new question and new possibility for the future for us to think about.

Bruke Kifle: That's beautiful. I think the MIT Media Lab does a wonderful job of doing what you described, which is, imagining the future and blending a wide range of disciplines, whether it be architecture and computing, whether it be biology and physics. So I noticed that even in your area of research, it seems to draw on many domains from computing to biology, psychology, neuroscience. So how would you describe your area of study? I think you described it as the intersection of synthetic virtual humans and synthetic biology. As someone who may be new to the field or may not have much of a background, could you describe your area of study for me?

Pat Pataranutap...: Sure. Our group is called Fluid Interface, and it's not about water or liquid, it's fluid in the sense of seamless interface between human and machine. And Professor Pattie Maes, my professor who leads this group, has been working in this area for quite some time now. And the idea of what fluid interfaces mean also evolves over time, it started off as thinking about how humans can actively receive information from for machines. So not just having passive machine that wait for us to activate it, but thinking about recommendation or agent that can recommend information to us. That I think is the first wave of Fluid Interface, creates seamless and active information agent.

And it's interesting, Pattie had launched many startup because of that and it has changed the world. And then Pattie was a little bored with the idea that having this active agent behind a computer screen, so it had led to the idea of, maybe can we put this information agent on the human body? This area of research

become what we now know as a wearable technology, technology that are on the human body, people that have start Google Glass or VR AR Glasses, we're part of that era at the Media Lab, they call themselves the Borg, where they think about wearable technology on the human body. And then that right now is commercialized, you have smart watches, many companies are working on that. And recently, we had some excitement about the metaverse or the virtual reality, so many of that was rooted in that second era of thinking about human machine integration.

And now, I think we are in the third wave of what we call Fluid Interface, which is thinking about not just providing information on the human body but provide what we call augmentation or enhanced capability because we are overwhelmed with data, we don't just want to wear more glasses or any auto wearable devices, just give us more data, we are already overwhelmed with that. So how do we reimagine new devices that not just throw information at us, but rather give us the ability that we want? Like ability to pay attention, to think critically, to be more creative, going beyond information to augmentation is the new area that we are focusing on, we call it human augmentation or rather human cognitive augmentation to be more specific. So that is the newest or the third wave of fluid interface research, and that's the area that we're particularly working on right now.

Bruke Kifle: There's a very clear need for the interaction between machines, technology and humans, and I'll get a bit more into some questions around some of the limitations but also future directions for what you described as wearables. But I'll start off, I was reading a bit on some of your research and I think one of the things that got me pretty excited was the clear practical applications of your work. I'm sure this is probably a result of the emphasis that MIT Media Lab has on practical applications of some of the research that folks are working on.

You've been involved in various projects that use humans and machines combined to improve learning, to improve wellbeing, to improve decision making, to detect mental health issues. I would love to start by learning about one of the projects which I think is very interesting, which is human AI co reasoning. What is it? We often think about the success of AI or we optimize the performance of AI as an entity on its own, what is this idea of human AI co reasoning?

Pat Pataranutap...:   That's a really cool question, and I think that is one of the thing that our group have been exploring. In the past, we have been thinking a lot about how do we optimize AI on itself. Eric J Johnson, who used to be at MIT has a really cool term called the Touring Trap. He said that, well if touring is a really cool person and he has created this amazing field of AI, but he also had led the trap for how do we evaluate AI. And for him, it's about, how do we replicate human intelligence? If the AI can trick us and into believing it's an AI, then it has shown intelligence. But that by itself is a trap in a way because you are forcing people to think about, how can I use AI to replicate human intelligence?

What he argued that I think is really interesting and I think is a vision that our group is exploring now, is thinking about how the AI could augment human capability rather than replicating human ability. So instead of making an AI that is like us, can we create a new AI that is augmenting us or complementing our intelligence? And when we talk about intelligence, we are not just talking about one way of intelligence, we are thinking about creativity and rational thinking. Sometimes it's the opposite of one another, sometimes you want to be more creative, sometimes you want to be more logical. And in our group, we work on several AI intervention that are augmenting our cognitive capability in different domain.

The project that you mentioned, wearable reasoning or wearable or human AI co-reasoning really explored the question of, how can we use AI to help us become more critical in the way that we process information? As you know, we are living in the era where we have many misinformation, we have many fake news, we have a lot of information that are harmful to us. Can we use AI to augment our ability to process this information and teach us critical thinking? So in that project specifically, we explore a way that we can integrate an AI that is trained to pick up logical fallacy or picking up linguistic signal that can be the indicator of misinformation and put that in variable device. So in the future when people going around in their life or doing works, they will have this AI integrated into a wearable, we call it a second brain, that help them process information so that AI can give you maybe a whisper to you like, this information that you encounter is lacking, evidence to support it, maybe you should think more or do some more research before you believe in it.

And this just micro nudging, we have shown to actually improve human critical thinking in terms of, people tend to be able to distinguish between information that is lacking any support from argument that have support. And we also further demonstrate that the AI would work best to help people reason when it can explain its decision, when it can explain to you why it made that decision or why it made that suggestion. So in that project, we also show that explainability and trying to have an AI that explain itself is very important for our human AI core reasoning. So not just that it needs to help human reason, it also needs to be able to provide the reason for itself. And that's the area that we are working on.

And right now, we have expanded that to multiple domain. We are exploring that in the form of wearable, in the form of virtual agent, maybe the AI doesn't need to be in your glasses or in wearable device, it can maybe show up on the screen. And we are thinking about what personality, what appearance should show up should it show up like Socrates, the great philosopher, like come and challenge you, make you think more critically or should it show up as maybe someone that you like or admire?

The appearance of AI has also been something that we explore. And thinking about if we were to have more AI in our daily life, what are this social dimension

that we should explore? The personality of AI, the appearance of AI, what question it should ask you. This is the interdisciplinary research that we are exploring, thinking beyond how do we optimize the AI, but how does the AI interacting with the human change the way that we experience our life and the way that we will work in the future? So that's the research we are working on.

Bruke Kifle: Very exciting. I really like this idea of nudging, I've actually seen that employed across various domains, whether it'd be nudging on my smartwatch, telling me to take a break or to stand up or to make sure I'm walking my number of steps for the day. Are the primary applications that you're pursuing now for misinformation or fake news detection, do you see other application areas, whether it be in HR, in health, it seems like the applications are very wide here?

Pat Pataranutap...: Yeah, definitely. I think one area that I'm particularly excited about is the idea of AI for education. Right now, we have many powerful AI models and they are really exciting and many more research are creating more and more models, last language model, generative image model. These are very cool by itself, but thinking about how they can really improve the way that we learn is also really interesting. Professor Seymour Pepper, who is a legend at the Media Lab said, we cannot think about thinking without thinking about thinking something, that is a really powerful phrase to think about.

But I think going further, we should think about how do we think with the thinking machine, when the AI are starting to have this amazing capability of generating new information, can we use them to make learning not just about critical thinking, but learning in general more exciting and more fun? Can we use AI to really personalize the content to make the learning material be more individualized or targeting the interest of each individual? Or can we use this AI to allow children to be able to have an expert opinion? One of the project that we work on the area of AI generated virtual human was thinking about, can we use this AI to create a virtual peers? Maybe if a kid wants to learn about physics, maybe they can have a virtual Einstein that provide them with state-of-the-art research in a way that they can understand. Or maybe if they don't like Einstein, maybe it could be a virtual superhero or any other character that is personalized and based on the student's interest.

And with that, right now there a lot of conversation about, should we ban the language model or should we ban an AI because it can answer a question and children no longer need to write essay? For me, and I think in the Media Lab in general, we are thinking about, of course, new technology is going to come in and it's going to challenge the way that we think about learning, maybe in the future, kids no longer need to write essay because AI can already do that. But together, can we think about new education paradigm where children with the power of technology can do things that even the teacher today cannot imagine.

Maybe with the power of AI, virtual assistant, or virtual learning assistant, children of the future, maybe at the age of five or 10 years old would already

achieve something that a PhD student at MIT 20 years or later can do. Can that accelerate the capability of people to learn and make amazing things? Like maybe children of the future will be able to kill cancer in middle school or something like that with the power of AI. So that I think is the exciting vision for the future, how do we empower learning with the capability of AI?

Bruke Kifle: I certainly love this much more optimistic view, I think there's been a mix of response from both the computing community or the AI community, but also the general public. And it seems that most people are very quick to suggest that banning the technology is the right thing to do. And while I agree that policy and moderation is necessary, I think your viewpoint is certainly much more optimistic, which is, how can we think of education of the future or students of the future where perhaps they're not spending their cognitive abilities on writing essays, but now they might be thinking about more critical world issues or thinking about how to solve some of the major problems that we're facing as a society? So it's very exciting to see that folks at the Media Lab are optimistic on how we can reinvent or think of a new paradigm for education using these foundational models and technologies.

Pat Pataranutap...: One vision of the past, the philosophy of the past that I really appreciate is the vision that was led by Manfred Klein, Nathan Klein. These two people have coined a term cyborg, and it's in contrast to today perspective that cyborg is about losing humanity and becoming more like a machine. In their original paper, they say that the idea of cyborg is to use technology as part of a human body, and it's not about becoming more like a robot, it's about becoming more human than ever. So you can use technology to do the things that is mundane and repetitive and a routine job so that human can be more free to think, to create, to explore and to feel. And the term cyborg was coined in the context of the early era of space exploration, and at that time they're thinking that the space is so big and we by ourself, the biological body, can no longer go into the deep space, so we need to augment ourself with machine.

But I think that idea of using machine to make us more human than ever should apply into the way that we think about technology today. Or why do we want to be a robot? I think we should remain human, remain having our agency and freedom to explore things and use technology to expand that capability. We take that, we at the Media Lab, we are the optimist, we try to not just see technology as black and white, but the way that we can really empower people with new technology. So if we take that perspective and imagine what learning could be like, the universe is so big, we have so many question that we are curious about, where we are from, what is out there?

Learning should not be constrained by what we know, but what we don't know. If we can really empower children to play, in the Media Lab, we think a lot about lifelong kindergarten, that's a really awesome group at the lab, but really explore the future of learning. We think a lot about playful learning and constructionism, the way that we can construct new knowledge. With the

power of AI, I think that would really enhance or really accelerate the way that we learn and think about new challenge for humankind.

Bruke Kifle: Certainly. I think any technology has limitations or the advent of any technology has any negative use cases, but if we are optimistic, the positive impact that technology can have far outweighs any negative impact. So it's very exciting to hear some of the viewpoints that you have. I want to go back on the wearable reasoning project or device that you mentioned. We're speaking or this is an audio conversation, so I can't physically see or you can't physically show me what this device looks like, but can you describe what this wearable device look like?

Pat Pataranutap...: Yeah, we have different iteration of this, but one of the recent iteration that we have is actually now exhibited MIT Museum in the AI exhibit. So if anyone come to Boston or come to Massachusetts, I would encourage the audience to go and visit that, they have really cool ... and they have not just our project, but many amazing project from MIT that really highlight the evolution of AI throughout the history, and our project is one of the recent of what human AI interaction would look like.

Bruke Kifle: Specifically manifest as a screen, as a device that you wear, augment your vision, I'm curious to learn a bit more about what the device actually looks like.

Pat Pataranutap...: There are different ways that we can present an AI to a person. In that project, specifically we focus on audio interface or voice interface. Particularly, I'm really interested in the way that the AI could become the second inner voice, when it whispers to us, can it be the voice of reason or a second brain that provide us with second opinion? So in that project is a glasses with audio and microphone and the Bluetooth capabilities can connect with the computational power in the cloud. This is where the AI exists and process the information and we try to make an, as I mentioned, make an explainable AI so it cannot just provide feedback to the user like, this is reasonable or this is not reasonable. But provide a method, analyze this like, why does the AI think that this is reasonable? And see if that could improve human decision making. And we found that it was really effective in helping people discern misinformation from an honest information, so that's what the current wearable look like.

Bruke Kifle: Very interesting. I've seen a range of responses to wearable devices. I think in the first era of wearables, we've actually seen many limitations that led to, unfortunately, the failure of many moonshot wearable technology. I think you described some with Google Glass and now with the Metaverse there's usually high price, there's the physical inconvenience of the device, it's very obstructive to your day-to-day activity, it's heavy, there's concerns around privacy and safety. So when working on wearable devices, how do you think about some of these challenges? Is there a future to what wearable devices looks like to help address some of these concerns or pain points?

Pat Pataranutap...: That's a really great question. The social acceptance of wearable device change and evolve over time as well. I think earlier, people think that the glasses would be the best form factor to deliver the information to the person, that's why we had so many glasses in the beginning. And now, it seems like the form factor that seems to be more widely deployed is the glasses. One other thing that we think a lot about in terms of when we create new devices is that, can we piggyback on things that people are already familiar with? These two devices are based on objects that we have already encountered our in daily life, like the glasses or the watches, they had less computational or capability in the past, now we have new ability that we add to them. So I think the key to success for this variable is to think about ways that it can integrate seemly into our daily life.

And of course, we're going to see more evolution of that technology in the future, but it seems that what people care a lot about is not just getting more information, as I mentioned, more information doesn't lead to productivity or improvement in terms of our ability to use that information immediately. We should think about how the technology really provide the value to the people. And our group have been looking at the cognitive augmentation, but there are many other area like, can this device sense information that we never sensed before?

Right now, one of the trend for deploying wearable device is to use this technology to do things that we used to do in hospital, like measuring high quality heart rate and respiration and skin conductivity and aerosol and other things. These used to be things that we do at hospital, now they've become integrated into our small wearable that we wear. So I think there are many advantage that this technology will provide in the future, but thinking about what are the real values that they provide to human, I think it's really important. Not just taking for granted that having more information would be useful, thinking about what are the real values of having that information or what augmentation can come about from that information, I think that's the important part.

Bruke Kifle: To do that, do you find yourself speaking with potential users of the technology or do you have focus groups, studies that you conduct, maybe engagements with community? How do you better understand, not just developing technology for the sake of developing technology, but for the purpose of, as you described, providing value or utility to the people that you're developing the technology for?

Pat Pataranutap...: That's an important question. I think in the Media Lab, we tend to be more imaginative, sometimes we explore needs or challenges that are not a big issue today, but could be in the future. For example, we have been working on many space projects related to augmenting human capability in space as we become what we call interplanetary species when human can travel across different planet, which has become more real than in the past. In the past, we tend to

think of this as science fiction, but with the recent space race in the private space industry, we start to think that these will become more important in the future, especially if we are going to have longer space mission or deep space mission where we go into a further planet.

And with human space mission, people tend to think about rocket ship and spacecraft, but I think one important area is also the space health. How do we use wearable to really allow people to have healthy lifestyle or healthy life in space? I think that's a really huge and important issue. So we have been working with NASA TRISH, a best specialized unit in NASA that support the advancement of space health and MIT space exploration initiative, which is an initiative from the Media Lab that really think about, how do we humanize the space exploration, how do we focus on the human aspect of space exploration?

We are working on wearable system like wearable app on the body and wearable bioreactor that allow astronaut to be able to sense new information from the human body and be able to provide intervention on the astronaut suit itself. Because when you're in space, you don't have the ability to go to hospital, there's no Harvard Medical School or MGH around. You need to think about, what medicine can you pack into wearable device or on the astronaut space suit so that if you're safe you can have that healing process or that treatment right away? So that has been an area that we work on and that work had led to a community actually called SpaceCHI.

We have been hosting a workshop for the last two years at a ACM CHI which is the largest conference in the area of human computer interaction. We have been creating this spatial gathering for people that are working at the intersection of HCI, human computer interaction and space exploration. And in the past, it's just NASA people, we talk too many people from NASA who say that, in the past, it's just us thinking about this question of how do we augment or allow astronaut to live healthily in space or to be able to work effectively in space? But now, many researchers are thinking about it, many designer, many artists even are thinking about this challenge because space exploration has become more democratized and more and more people are thinking about how they want to define the next generation of human life in space, so it's really exciting.

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Bruke Kifle: It seems like your focus or your research motivations aren't even just thinking about solutions to existing problems, but it's also identifying new problems that have not yet been clearly voiced or clearly formulated. I really love the work that you described with wearables for health enhancement and space. Do you see this being applied for those who are on earth? I think even beyond applications in space, maybe there are seniors or folks who may be receiving in-

home care. Are there applications even here on earth for some of this technology?

Pat Pataranutap...: Definitely. Many of these powerful or advanced concept like the idea of cyborg that has inspired early work on wearable technology, the Media people called themselves the Borg, was in the context of space exploration. And I think space exploration has some magic or some powerful vision that really inspire new innovative ideas. If you're thinking about maybe a solution on earth, there are more practical things or things that you can deploy with lower cost. But when you're thinking about space, it really opens up your mind or the way that you think about the problem in a new way. So that's why many of the technology that we're using today from GPS or even microwave that we are using in our kitchen, this technology that we are taking for granted today will actually develop in the context of space exploration.

As we think further into the future, sometimes the research that we create for that extreme use case, but eventually they will become more democratized and more accessible to group of people as well. But thinking about that right now may not make sense because, as I mentioned, there are more practical solution. So I think one of the goal of the Media Lab is to always look at the new frontiers and searching for new possibility, things that make people question, why are you doing that? But then once it reaches the level of maturity that we would expect, it'll have tremendous impact on human society. So I think that's our job to be maybe less practical now, but more impactful in the future.

Bruke Kifle: It's always crazy until you actually achieve it, so I think pushing the frontier of science, the return is certainly there. I understand one of your experiments actually recently was launched to the ISS, the International Space Station-

Pat Pataranutap...: Yes, exactly.

Bruke Kifle: ... Can you tell me about that? That's actually pretty awesome.

Pat Pataranutap...: As I mentioned, MIT Media Lab has a really cool unit called the Space Exploration Initiative that work across different group in the Media Lab to explore ... our project in the Media Lab are always crazy out there and at the forefront, but many of them are targeting earth based population or earth based user. The space Exploration initiative really push the Media Lab to the next level where we're thinking about how can we deploy some of the things that we think about on earth in space. And the project that you mentioned is actually one of the project that's built on top of the early work that I have done on wearable technology for astronaut. In this project, we are looking at how do we create bio digital system that allow us to control the growth of bacteria in space so that we can use these bacteria to do multiple things, help recycle material in space, help us produce medicine and do other things.

We have been exploring how do we create this automated bioreactor that is digitally controlled, but allow us to understand and grow genetic engineer bacteria in space for human benefit, and that has been a really fun project to work on. And it was launched actually before New Year to the International Space Station, and this project is a really fun collaboration among many groups that come together to explore this. And now, it's just return from space to us, we are going to be busy analyzing the result in the next month or so. And I think it's going to really show new possibility on how we think about Bi digital interface in the context of space exploration.

Bruke Kifle: Well, that's very exciting, I'd love to hopefully learn more about or closely follow some of the results. I don't think many folks can say their experiments have been launched to the ISS, so I think quite an accomplishment, and I'm sure the results will be equally interesting.

Pat Pataranutap...: When you work on space mission, it's always like you are in some a science fiction movie. You think about, what's going on? What challenge do you need to solve? I really love the phrase from the movie The Martian, out of the solution, you need to science your way out of the problem. I think that's really true when you work on space mission, there's so many problems, so many challenge that you need to face and when you fix them or when you solve them, your mission, get to go to space and it's very excited about that.

Bruke Kifle: Very interesting. We talked about a couple different interesting things that you've worked on and your research has been published in various journals, featured in various media outlets, you collaborate with stakeholders in academia and industry with NASA as you described. What is the impact that you hope your research will have on the future of human computer integration or human AI interface?

Pat Pataranutap...: I think of the impact of my work in three ways. For the first level, I think of my work as showing a new prototype or a new artifacts, things that people would think, why would you do that? Or things that people think that, it would never work. We will make the first prototype, we will make that first attempt to show that this can be done, maybe it may not be the most effective prototype or may not be the most practical things that you can use today, but it's the first step to show that it's a possibility, so that future research can improve and work on that. So that's the first level, to show new prototype, new artifacts that really bring crazy ideas into something tangible.

The second layer of impact, is to really show an experiment to show that, the thing that we make have this impact or this improvement on human life. You can see some of this in the experiment we do on human AI interaction or on some of the space project. We have real scientific experiment that we validate our work and we have shown that it has improved our human life into our decision, health, creativity or whatever, to show the experiment it's really cool.

And then the third layer, is to really deploy this in the while to see if it really has impact on human life. I've done some project that was deployed during the COVID pandemic, like the chatbot that help people retrieve certain information or design of a project that look at how we can optimize the flow of people getting the vaccination. This project is maybe less futuristic, but can be deployed and really save human life. Like the chatbot project was used by over millions of users worldwide and the vaccination site that I co-designed with people in my team have really accelerated the process of vaccination.

We don't focus on just practical things, but if we have a chance to really push that or do something in that area, I think that's also really impactful. These are the three ways of my contribution to the research community and to the world basically to offer new crazy prototype, ask question and experiment on things that we never thought of, and finally deploy some of these ideas and solution into the real world.

Bruke Kifle: Well, that's awesome. And as I said before, it's only crazy or it only seems impossible until you do it. And at the end of the day, I'm really always excited and fascinated by the strong emphasis on practicality on how does it improve human conditions. I think many technologists can be motivated purely by scientific pursuit or just the happiness or satisfaction that comes with pushing the frontier of science as we know it. But I think there's also another aspect which is thinking about, how can it be applied to improve society or human life as we know it?

I really love your perspective or your take on things, and I think one of the things that I found quite interesting is that, outside of your scientific pursuits, you also bring a very strong passion and love for art. And many of your work has actually been featured, I was surprised to see, in museums and galleries around the world. And from what I observed as you described, you also have this entrepreneurial spirit or this entrepreneurial drive, you worked on projects before graduate school, you've been working on projects with the COVID chatbot as you described, you've co-founded various programs and initiatives. Can you tell me a bit more about these two passions, your love for art and then also this entrepreneurial drive?

Pat Pataranutap...: In the Media Lab, we have this four area that we often describe the way that this thing is connected. We call it the creativity cycle, and it's about how art can inspire science, how science can inspire engineering, engineering inspire design, and how new design will continue that cycle by inspiring new art. So that's one of the ways that we think about how creativity happened, is when new discipline are collide and connected with one another. I was fortunate to work with many artists that I collaborate with to really explore the implication or the new question that can come about internal artistic practice from my project. Because oftenly, when we work on really advanced technology, whether it's AI or space exploration, it's really beautiful. And in terms of the aesthetic of it or in

terms of the question that it bring about, and art I think is a way of asking question and be imaginative and exploring the hidden question to that.

So many of my artistic project have been exhibiting around the world and it has really opened my mind in terms of what this technology is really about. Sometimes it's about criticizing the work and sometimes it's about opening up new way of being expressive. So for example, I've been working with a Thai artist, Cavita, on creating an AI or clone of her to have a debate so she can be in the middle of two AI that is based on her own data talking to one another and exploring what would she actually do when she externalize her mind into multiple AI that are debating on important issue. And that performance has been featured in several museums and has really ... it's not just that I enjoy working with her, but it really opened up my mind about new research possibility in HCI as well. So it's not just about making art, but how art really inspired new research.

And it's not just artistic community, I also engage with startup community and industry. That's one of the strength of the Media Lab, that we get to have member companies and they bring new perspective, new challenge for the industry to us. And we have the privilege to be more crazy and say to them that, to your problem, we have these crazy ideas and that is beneficial for both of us because for us, we get to see a new challenge, insight on things that we never thought of. And for the member company, they see new crazy possibility that maybe they never thought of. So that's always fun as well to think about how the work that we do can go into multiple channel artistic output or industry output.

To me, my work is about, as I said, augmenting human capability and I want to be expressive and use this work in many ways. One of my goals is to live an expressive life to be able to express my idea and thinking in term of research, artistic project, and solution for industry and startup and social impact. And I think that's the fun research ecosystem that I've really enjoyed at Media Lab.

Bruke Kifle: That's awesome. So it seems like science and these outside interests or pursuits are not independent or mutually exclusive, rather they actually help motivate some of your scientific pursuits and contributions?

Pat Pataranutap...: Absolutely.

Bruke Kifle: Awesome. One of the things that I loved in your bio is this idea of moonshot thinking to create a future innovation. So as someone who actually believes this crazy ideas and this idea of thinking about the future, how do you find you're best able to channel your creative or moonshot thinking? Do you have a specific process? Do you have specific frameworks? Do you like to go on walks? Do you think of these ideas when you're in the shower? Where do you find you are able to be at your best when it comes to really thinking about these 'crazy ideas'?

Pat Pataranutap...: I think I said it many times, but I think that your questions are very cool. And for me, I always think that innovation is never a straight pass, it's never like, you walk into an innovation and boom and it becomes a world changing idea or things like that. It's always like a walk in the forest, you go and you see that beautiful tree and then maybe it makes you think of something and then you walk and then you see another tree or maybe you see a dinosaur in the forest, and it's always an adventure. And if you look at the history of how powerful ideas come about, it's never happened in the formal context or the context where people are like, I'm going to make something. It's rather happening in the very unexpected environment or in a very unusual place.

For me, one of the reasons that I would love to work in this different domain like artistic project and industry project and research project is that, it really makes your mind flexible to think across different possibility. I think that's one of the thing that I really appreciate about being at a Media Lab, is that I get to be flexible and go into that different area. And you asked about what is the best time to have that crazy idea, I think walking definitely can really help, it helps you be stimulated as you walk to the environment. I love to walk in the park in the afternoon or in the morning to get new ideas and listen to music that put you in the flow state, and sometime showering in hot water also really helps.

And what I find interesting is that, it will never come to the thing that you expect, it always go in a different direction. But then at the end, if you figure out the connection, it'll be something powerful and awesome at the end. As I mentioned, it's never straight path, it's always a complex and malleable thing that you need to keep molding it and keep pushing it and keep thinking about it and then it will resolve in into something interesting.

Bruke Kifle: That's awesome. So there's something to be said about, oftentimes, we explore solutions to solve problems, but sometimes we think about how we can apply existing solutions to be applied to problems that we've probably never explored before. You've worked on some cool applications of wearables and machine learning for learning and wellbeing and decision making. So do you often find that you find yourself identifying problems first and then thinking of ways where technology could be used to fix these problems or provide a solution to these problems?

Or is it the other way around? Or maybe you think about, these are the capabilities that we have today with large scale language models or wearable devices, and then you think backwards or you reverse engineering, you say these are the problems that now I can solve with this technology. What's the framework that usually drives more of your research or your new explorations?

Pat Pataranutap...: For me, I think there's no one formula, sometimes you are inspired by the new advancement in technology and in AI, for example, new models always fascinating to me. And sometimes you have a vision of like, would it be cool if we have this kind of thing? And once you think about it, what are the

ingredients that do I need to put together in order to make that? Is it new model that doesn't exist or is it new data set that I need to go and search for? So I think it happens in both ways, sometimes you see some interesting ingredient and you want to cook something awesome out of that, or sometimes you think of a meal like that you want to make and then you think, what are the ingredient that I need to go find in order to make that? So I think it happened in many ways.

And sometimes people criticize the futuristic work that we do at the Media Lab at like, you're creating solution in search of a problem, you're not solving real problem. But sometimes that's what we need, we need to imagine new ways to live alive. And sometimes it's not about using technology to fix the existing problem, but rather to reimagine, how do we recreate or reimagine that whole scenario altogether? And the lab have shown a really good track record of how do we reinventing that. For example, the early work on touchscreen that I think it's a very fun example to think about. When the first touchscreen came out from the lab, I think it was the architecture machine, it was the precursor of the Media Lab. But Professor Negroponte, who was the director of the Media Lab, he said that he was heavily criticized for exploring the work of touchscreen.

And the first touchscreen that came out from the lab was criticized, human hand is so messy, if you touch the screen, it's going to make the screen messy and dirty, no one is going ever use the touchscreen. Those are valid reason, but the thing that we never imagined we could do with touchscreen outweigh that small issue. So I think sometimes we don't know what the future going to look like, so we should keep exploring and explore new possibility, not constrain ourself in one way of thinking like, I'm going to only solve problem, or I'm going to just create things that doesn't exist. But be flexible, sometimes work on things that are practical, sometimes work on things that are imaginative and the two will feed off each other and make you become a more creative person.

Bruke Kifle: Certainly. One of my favorite sayings is that, good players play where the ball is, great players play where the ball is going to be. So I think in pursuit of future problems, sure, they may not be the problems of today, but they are the problems of the future. And if we can proactively think of solutions or explore ways to address those problems, I think it's better for us as a society in general. So quite exciting to hear that.

I want to conclude with open questions for you. One, what are some exciting developments or future directions that you see in your research that you're currently working on or that you're excited about exploring? I think you mentioned some things around education, I think you also mentioned some things around the excitement of these large models. But are there any exciting developments or future directions that are keeping you up at night, so to say?

Pat Pataranutap...:   Well, so I often think of my work as a two paradigm. One, is about bio becoming digital, and another one is about digital becoming biology. What I mean is that,

as some of the project in space exploration really show that we can really program biological machine, like how we program digital machine, and this is about synthetic biology, how can we program bacteria and things that are on the human body itself to become a digital mini microcomputer on the human body.

And the other area is about, how do we start to reimagine digital system as a biological system? So start to look at these large language model, not just as computational system, but similar to a biological neuro network, we need to understand how the AI work in the same way that we need to understand how the brain work. And the complexity of the AI system today, I would argue, is getting closer to the level of human brain complexity. And we don't have tools to really study either the human brains and AI model at the resolution that we need to really fully understand what's going on to work on explainable AI is emerging, but we need more work of that kind, especially on large model that are very stochastic and model are very complex in nature. We need to really learn from biology using bio to create new digital and using new digital to create new biology. It is a puzzling idea, but I think it will really open up the way that we think about computing of the future.

And, of course, for me, I think one of the theme that we discussed is that, technology itself is neither good nor bad, it's about how we really deploy it and the way that we interface technology with human is not something that we can take for granted is all by design. My adviser said that, you cannot just make an awesome AI and expect that when you drop it to a human population, they'll be able to use it immediately and use it in the right way right away. You need to really think about how this tool can coevolve with one another, this is also a very biological concept, like how to system co-evolve with one another. So the interface itself is really important. The media philosopher really said that the medium is the message. So when we work on this awesome or exciting new technology, the interface, how it connects with people is really something that we need to pay attention and design for.

We talk about large language model and many large AI models, they are really awesome and have many benefit, but that benefit will not happen if we just think about that system alone without considering the human psychology, without considering how the human would over rely on it or how we can really design to promote creative use and critical use of that technology. It's not going to happen because of the system, it needs to happen by design, so we need to pay attention to that. So I think these two areas, thinking about bio becoming digital, digital becoming biology, and thinking about how we create AI system that co-evolve with human in the longer term are things that I think a lot about.

Bruke Kifle: As we continue to see technology being so widely adopted in every aspect of our lives, and especially with at least the growing emergence of AI technologies, I think exploring both research paths is very important. And I think as long as we

have folks like you who are thinking hard about these problems or hopefully we have more, I think we're all in good hands.

One final question I want to ask, for those in the younger generation who might be interested in the field of computing, what advice would you provide? And one thing I specifically want to ask about is, it seems like you've been able to balance your passion for science with some of your interests in art and entrepreneurship, so how would you advise those who are looking to balance some of their scientific interests with their passions, whether it'd be art or music or sports, to best channel and fuse those interests together as much as possible?

Pat Pataranutap...:   And dinosaur as well.

Bruke Kifle: And dinosaurs, of course.

Pat Pataranutap...:   To me, what I've learned and seen at the Media Lab is the celebration of diversity in broader sense possible. You see a lot of interesting and weird people at the lab and they all really show their unique perspective and unique appreciation of things. And I think that would lead to a creative community when people can really bring what they're passionate about to their work and that passion will spark ideas and imagination in other people. So that energy is really important, not to constrain yourself to becoming a flat dimension or a one dimensional person, but really celebrate who you are as a human being. If you love dinosaur, then go for it and bring that to your ideas and creativity. So I think that's really important.

And one thing, for me, that I think is also really important, is to think about what impact that you want to have in the future. One of the media lab professors, you probably know professor Hiroshi Ishii, always asked all his auto Media Lab students, what impact would you have 200 years after you die? And I, of course, don't have the answer immediately, but it's something to think about, to have a bigger question or something that is bigger than life to think about, whether it's a philosophical question or things that make you don't just stuck in the moment, but be more transcendent in terms of your thinking, I think that's also really powerful.

And finally, to embrace all the complexity of the world. We are living in the era where technology is moving at such a rapid rate, and we need thinking, and all kind of thinking, not just scientific thinking, but artistic thinking and all creative methodology to really help us understand how we are going to live in the future. And it's not just about dystopia and it's not just about utopia, it's about the mix of all the good and the bad and the negative and the positive. So exploring all the spectrum with embrace all the complexity and all the possibility ways and ways to understand it, I think that's the way of the future.

People often ask me like, am I going to be replaced by AI or am I going to be replaced by a robot? And I think what is really powerful is to think about, we talked about this earlier, about education, to not think about technology just as tool that replace human, but things that can really allow us to think of things that we never thought of before. The augmentation, the idea of cyber becoming more human than ever, children of the future will definitely experience this more. They should not be afraid of it, they should think critically about it, but then at the end, think about what can we invent to really up live human humanity?

One of my friend has said that to imagine a dystopia is easy, it's easy to imagine how the world to end, in many ways, it could be alien attack, climate change, whatever. It's easy to imagine the dystopia, but to really imagine how we going to make it, how we going to really turn the scenario around, that is the challenge that we as a researcher, scientist, artist, designer, engineer, whatever we are as a person of the future, need to really think about. Be optimistic, but also critical at the same time.

Bruke Kifle: With people like you, the future is bright. And I've certainly taken good notes on some of the advice that you've shared. I really enjoyed this conversation, and I look forward to seeing many of the great contributions you will have and will continue to have in the long future. So thanks so much for joining us on ByteCast, and look forward to keeping in touch.

Pat Pataranutap...:   Thank you for having me.

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