Affective Computing
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Week - 11
Lecture - 02
Ethical Concerns

So, far we try to understand in a very simplistic fashion that what methods and techniques can be used to develop such an emotionally intelligent virtual agent. And I believe the possibilities are endless of course, in their development as well as while doing their deployment in the real world.

And nevertheless, when it comes to the usage of such a system, we always have to be very cautious about it. And in the next week we will be focusing on the ethical aspects of the affective computing in general. Nevertheless, I wanted to devote some time on for example, what could be some of the ethical concerns that are related to the this emotionally intelligent virtual agent which you may develop and may want to decide to use in some real-life settings as well, right.

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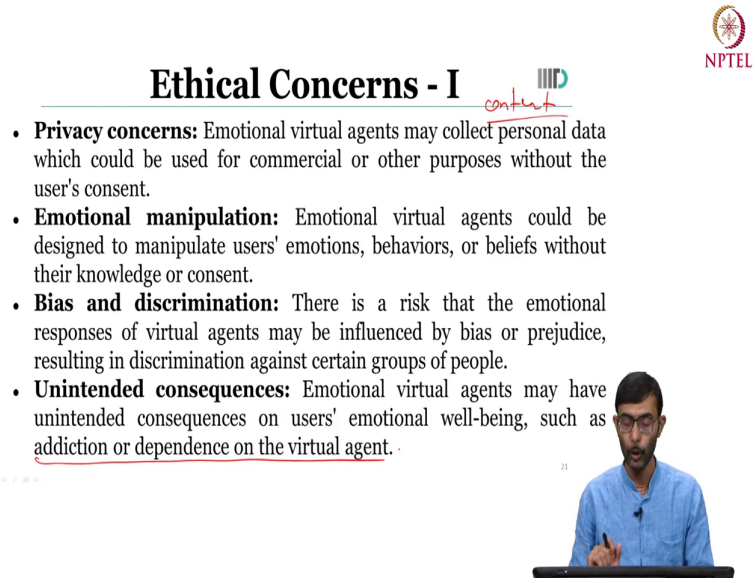

So, let us go ahead with that. Of course, the first Ethical Concern that we have also highlighted in the beginning of the module is of the privacy. So, it turns out that any such emotionally virtual agent that you are going to develop let it be used in a mental health session by a doctor or for example, in an education domain with some students or let us say you know in a workplace environment with some employees.

It will be collecting lots of personal data because unless and until it has access to the personal data it will not be able to personalize it, right. So, you may remember that we were talking about the context. So, basically this context it comes with the understanding of the users behavior and users personal preferences and all that.

So, it is we will be collecting lots of personal data. But of course, the problem is that if we do not have a proper regulation over it, then the this virtual agent that we are developing it can

be used to collect this kind of data and you know for the this can be sold for the commercial purposes and more importantly without even users consent, right.

So, that is the big challenge and of course, we do not want to invade into the privacy of an user and we would like to respect that. So, maybe this is some of one of the important thing that you would like to keep in mind. Other ethical concern is the of the an emotional manipulation. And this is common not only about the emotionally intelligent virtual agent, but it is going to be common across all affective computing applications.

So, the idea is of course, you know such an agent will be able to understand your emotion, will be able to respond to your reactions in an emotionally intelligent fashion and in turn, it turns out that it may affect your emotions. For example, you may be feeling sad and it would like to make you happy as simple as that. And of course, you know like it may want to nudge you to do some behavior and down the line maybe some belief system can also be changed.

And it all may happen without your knowledge or consent. And we have to understand that to what extent it is acceptable. Because of course, there is a manipulation of the emotional aspects going on and of course, it was not a concern before maybe by the AI, but because there was not a lot of talk about the emotional manipulation, but now since the manipulation is happening of the emotions, we need to take a bit at this as well.

Bias and the discrimination as with any AI system, this affective computing systems or this in this case this particular emotional virtual agents. Of course, they also have lots of bias and discrimination in place. We did talk about certain things in the beginning, I would like to emphasize it again. Imagine if you were to develop such a system, I mean it may not work for example, you know, one particular group, one particular ethnicity.

Imagine that you are using the data from western population, it may not work for the Indian population or if you are using the data only from one part of India, it may not work for the another part of India, users from the another part of India, one language may note one data collected from one language may not work for the second language and so on so forth, right.

So, then this is going to be lot of discrimination and the axis can be hampered in that way. Of course, then there are certain other consequences that we may not have imagined and may can also come such as for example, the addiction or the dependence on the virtual agent. So, the idea of this agent is what you want to create an agent which can for example, help in the emotional management of the employee or you know a student in any particular setting.

Now, of course, it may turn out that it is like your candy, you know. So, basically candy is sweet and you develop some addiction to it. So, whenever you want, whenever you have urged to it, you just take a candy. So, maybe you know like now you are try you will try to find this develop the same type of solace in the this kind of virtual agent as well.

So, whenever you are in the need of some emotional relaxation, you may want to you know like just talk to this virtual agent only which may not be a very good idea to begin with.

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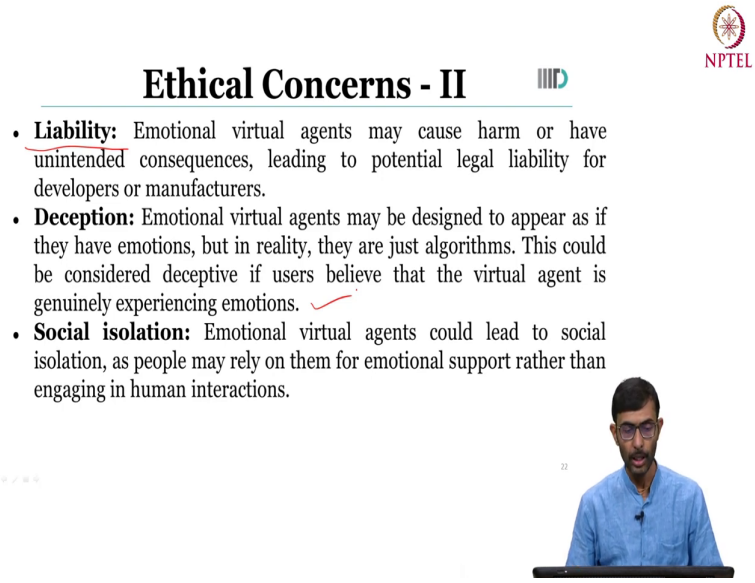

Because of course, it is going to cut your first thing from the social contacts and you will develop some sort of addiction to it which is not your natural state. Of course, apart from this you know like within this ethical realm also there could be a legal concern as well.

For example, which is a very very interesting concern which is of the liability. So, of course, you know while doing this emotional manipulation, while doing this you know developing this kind of addiction and all that there could be some legal liability for you as a developer or you as a manufacturer.

So, you may want to take that into account. That for example, if you were to place such a system for example, in a hospital where such an agent is interacting with the patients, if

something some to go wrong then who is going to take the blame for and who will be blamed. So, that is something liability which is really important.

Other thing is of course, again then there ethical concern is of the deception. So, this virtual agent that you are developing, it is not really you know emotional in the sense it does not understand the emotions, it cannot communicate the emotions, we are just trying to approximate the feeling of the emotions in the system and it can be deceptive.

So, we need to make the users understand that this is artificial, this is not a natural and hence the agent is not genuinely experiencing emotions. And for example, you know deception like there are lots of things that can happen because of this and if you recall we were talking about we talked about anthropomorphism also in the previous module.

So, basically, I will like to tell you one short story and I think that will help you understand what can this deception do in turn. So, for example, there was a simple robot that was developed for by US Army to detect and to refuse the bombs in the war, in the war field settings. And such a there was one such a robot I am not able to recall the name that was deployed with the US Army in Afghanistan I believe.

And then you know like during one of the operations you know when that robot was trying to detect the bomb and then the bomb you know exploded and the robot bleu well robot died at the some sort of robot died you know. So, it end out that you know when the robot died and the robot the remains of the robot when it came back to United States.

There was a lot of sorrow among the public and there was a lot of disappointment and grief among the not only the army persons, but also among the common public and it was widely captured actually in the media as well. So, I mean ultimately if you see all this thing, I mean the robot itself is not a living being, I mean its a artificial entity it does not have a life.

But of course, we are anthropomorphizing a particular artifact by attributing it some human like a rhetoristics giving it a name you know, making it do something like a human will do and building some sort of companionship. And, but at the end I mean this is sort of deception

because it is not human. And we need to make this very very explicit since the beginning for the emotionally intelligent virtual agent kind of devices as well. Social isolation we were just talking about the social isolation.

So, basically you know of course, if the users were to develop some addiction with this emotionally intelligent virtual agent, then it may result into some sort of isolation from the social gatherings as the users may tend to rely more for the emotional support to this kind of agent rather than you know engaging in the human interactions.

So, this can be again very very common scenario. And especially for example, in the healthcare settings where the agents who are the participants or the users who are interacting with this virtual agents are already you know under some sort of mental issues mental health issues such as for example, depression and they may not want to talk about with a human.

But then again, they feel more comfortable in talking with such an agent that you are developing and may ultimately develop an addiction to it and which may not be a very good idea to begin with, perfect.

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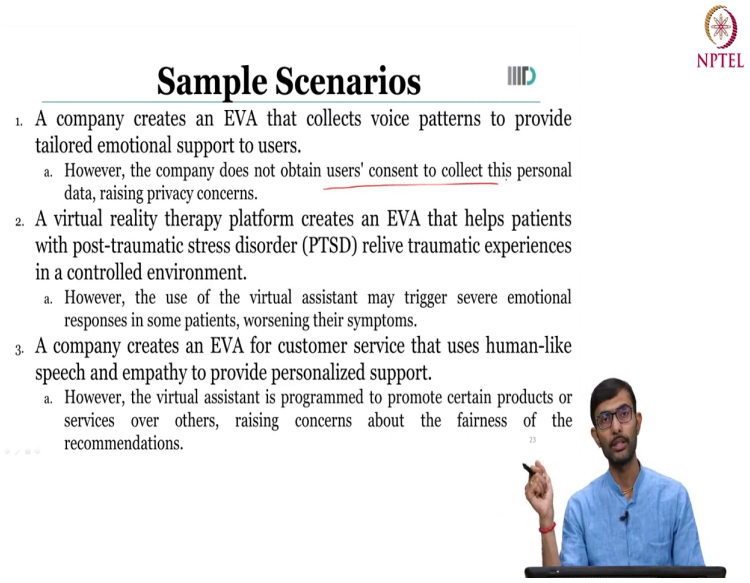

So, these are some of the ethical concerns that can be there by no means this is an exhaustive list. Of course, the exact understanding of the ethical concerns you can take these as a pointers, but you will have to understand the scenarios in which you are deploying your emotionally intelligent virtual agent. And also, what sorts of capabilities and functionalities are you planning to improve improvise in this agent, right.

So, and nevertheless let us take some example of some certain scenarios and see how it is exactly how these kind of concerns can arise and it is easily being manipulated. So, for example, imagine that there is a company, maybe yours company which is creating an emotionally intelligent virtual agent, that collects voice patterns you know and to provide tailored emotional support to the users.

So, what could be some of the ethical concerns related to it? I would like you to take some time and think about it, what are some of the ethical concerns that could be there. So, for example, one thing that we already saw that we are talking about the privacy. And if the company is collecting the voice patterns and maybe you know, it has not even obtained the users consent to collect this personal data, you know like then it is going to raise the privacy issues.

So, you rightly understood that in order to address the privacy concerns, of course, the very first thing is that you need to have proper user consent and you should not be doing anything beyond what the user has consented for, right. So, for example, you have obtain the consent to provide user certain services, you should not be just start selling the data without even having the consent of the user.

So, that could be, for example, one issue with this such a company for example um, ok. Let us take another example, a very interesting example. Imagine you develop a virtual reality therapy platform which is creating again making use of this again, you know EVA which is Emotional Intelligent Virtual Agent that helps patients with PTSD, relive traumatic experiences in a controlled environment.

So, basically these kind of practices are also not very uncommon with the war veterans. And to help them release the trauma that they have face during that may have, they we may have face during the war. Now, what could be the consequence of it? I want you to think about it and then come up with certain things. Of course, privacy is one thing that could be there, what could be the other concerns?

So, it turns out there are lots of things associated with it. But one of the things that really can happen, it can really worsen the symptoms of the patients who those who are going do through this said therapy. Because of course, you are want them to relieve their traumatic experiences, but it may happen that your virtual agent may not be able to control the intensity and manage the emotions and then you know it may severe their emotional responses.

So, you will have to little bit cautious about that. Of course, addiction is another thing that can be really happen and there are lots of other ethical concerns that can arise into this scenario. Let us take another scenario, which is where there is a company which creates another virtual agent for the customer service and it uses to provide personalized support.

Sounds like a very good plan and most of the companies would love to run this kind of system and I will encourage you to please think about it and maybe you know, turn it into a business plan as well. But now, what could be some of the concerns? Of course, privacy could be one of the concerns. We already talked about that emotional manipulation could be there in this case, which could be chance could be a bit limited because the users are not very exposed to this for long.

So, what could be some of the concerns that can come with it? Ok, this is really interesting observation. So, basically what may happen that the idea for this particular agent that you are creating was to provide a personalized support and of course, you know, to recommend for certain products or certain services.

But it may happen that it may not be fair at all while doing so. And it may be promoting one product over the others and hence, it is violating the trust of the user, which is you may know that it is already being done by lots of social media and technical giants around us. But this is also one of the biggest concern that can be there in developing such an agent.

So, these are just some sample scenarios, you know, where we try to look into that what could be some of the privacy and the ethical concerns related to it. And of course, as I said, these are just the pointers. I would encourage you to please, you know, think more about it and think about the users, think about the business use cases and accordingly, you know, you may come up with more detailed list and also accordingly, you can come up with certain solutions to these scenarios, ok.

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Interaction with Dr. Aniket Bera

So, now we have understood the ethical concerns and now next we have a very exciting session where we are going to have an interaction with Dr. Aniket. So, as I said before, Dr. Aniket is a faculty in Purdue University and having a lot of experience in affective computing and related areas.

So, in this particular interaction, we will be talking about some of his research and we will trying to address and understand how he approaches a research problem and you know, tries to convert into from an idea to a product or to a service. So, guys, we have Dr. Aniket Bera with us, who is an associate professor at the Department of Computer Science at Purdue University.

He directs the interdisciplinary research ideas lab that is intelligent design for empathetic and augmented systems at Purdue, working on modeling the human and social aspects using ion

robotics, graphics and vision. His core research interests are in affective computing, computer graphics, AR, VR, augmented intelligence, multi-agent simulation, autonomous agents, cognitive modeling and planning for intelligent characters. He is currently serving as the senior editor for I triple E robotics and automation letters.

In the area of planning and simulation, his work has won multiple awards at top graphics slash PR conferences. He has previously worked in many research labs, including Disney Research and Intel. Aniket's research has been featured on CBS, Wired, Forbes, Fast Company, Times of India, etcetera.

And you can know more about Aniket's work at https cs dot purdue dot edu slash hyphen ab. So, Aniket, we are really excited to have you. Thanks a lot for taking your time. And for the sake of the discussion, you know we will start with trying to understand that what really inspired you to pursue your career in affective computing.

Well, thank you so much for the introduction. Well, affective computing as you know as the name suggests, or as you know many people before me, many people you know have worked on it from a psychology point of view, from computational psychiatry, or even computer science. So, it is about modeling human behaviors and human emotions.

And that is one aspect which I always felt like kind of was missing in modern computing technologies. We have always optimize things based on certain principles, time, money, but we leave the human out of out of our competition. We leave the human emotions out of all these calculations. So, my whole research on bringing the human emotions, bringing human behaviors back onto the computing design is one of the reasons why I am, I work on affective computing.

Problems like ranging from can a robot serve you better if it did know your emotions, can a virtual agent in this meta verse realm, can it better understand you, can it better know you, if it understood your emotions? a good example I gave this, and this is one of the research, we

have working on with a hospital with therapists, is can I design this virtual therapist who know and understand your internal states?

And I was give this example to my students, is like, let us say your friend were to ask you a question, how are you feeling today? You can answer in many different ways. You can say, you know, I am feeling ok. You can say, I am feeling ok. Or you can say, I am feeling ok. These are all the same text. These are all the same content. But the way we represent this content is so different. My body language is so different. My vocal patterns are so different. My emotions are so different.

If I was able to understand this better, I can serve you better, I can help you better, in this case that I am feeling ok. Clearly, you know, this person is happy. If this person is feeling ok. But somebody, your friend, were to say, I am feeling ok, I guess. That is not ok. You want to ask more questions to this person. Maybe get to know a little bit more about if there is something bothering this person, right?

So, from psychiatry, computational psychology, social robotics in this meta verse realm, all of these need to bring the human at the center for all these discussion. Then that is why I feel all our research on affective computing really is. Perfect. Sounds really interesting. So, Aniket, if I may ask, like, which was one of the first work that you decided to do in the affective computing domain? And what exactly inspired you to, you know, move into that direction?

So, many years ago, you know, when I was doing my PhD and was do, you know, publishing papers in crowd simulation. So, we were modeling how people move in you know crowds, you know. Of course, I am being from Delhi. I know what it feels like on, you know, when I am, you know, I remember the time, like, let us say Rajiv Gandhi Metro station.

Or something, right? I, or Nehru place or these kind of places. So, I remember that when there is a lot of crowd, there is a lot of people, it is always a challenge to go from place A to place B. But within that challenge, this is always to be, ok. How do I optimize my path? You know, I see an aggressive person walking next, you know, cutting lines. Maybe I want to choose a

different path. If somebody is shy or more conservative person, I can cut across that path, right?

So, this is where all of this research initially started modeling crowds, modeling people when they are moving its crowds. Initially, we used to model them as just like circles or cylinders, you know, in a very simplistic representation. Of human beings, right? Unfortunately, human beings are not circles nor cylinders, right? We emote, we have body languages, we have expressions, we have. So, many different dimensions of, you know, perception to everybody else. So, one thing led to the other.

We moved from circles to full body gates, to gates we move to full body emotion representation to motion. We went to facial representation and now we kind of proud that we have modeled all of these, not just visual affect, but affect from vocal patterns, affect from visual, facial expressions, from body language.

So, yeah, I mean, what started something maybe 10, 12 years ago from crowd simulation is now at a more microscopic human-to-human interaction. Of course, a lot of things change in this 10 years, but I would like to thank my initial research to where I am right now.

Ok, perfect, perfect sounds interesting, thanks. So, I if I understand, well, you are already working, you started working in the affective computing may be 10 years back.

Yes.

But as of now also, I believe we have n number of active projects going on.

Yes.

In affective computing domain. So, can you please elaborate some of the projects and what exactly you are doing there?

Yeah. So, as I said, one of these projects is from we are working with Baltimore hospitals in you are. In, in, when I was at (Refer Time: 22:14) Maryland in before, we were working on, we working with psychiatrist, child psychiatrist therapist to and sort of bridge the gap between the, the therapy demand supply.

So, what happened is, when COVID happened, specially for single mothers or people who could go outside, they had, like the children were stuck at home. You know, they start, they could not go outside to work because of COVID, the children were stuck at home, they had to work remotely. A lot of these problems, even in a, I would say, quote unquote developed world, people were always, you know, the mental health problems increased a lot.

Unfortunately, the more rural we went, you know, in Maryland, the state of Maryland, we saw these problems escalated because of the lack of availability of resources. The nearest Walmart would be like 30, 40 minutes away, you know, people could not drive, leaving their kids at home. So, the mental health problems increase in week. So, I reached out to some of my colleagues in psychiatry.

Like, is this a problem we can solve? Can we bridge the gap between therapy available? Because there is limited number of therapists. But a lot more number of people actually need mental health. So, we wanted to say, can we help them? You know, these therapists are overburdened. They are doing. Like 20 patients a day, 30 patients.

A day, can we give them some supplemental information? Can we find causal relationships or what happened in the previous session the therapist might have forgotten something. Can we leverage, ok, this person was sad in the last session because certain so things that happened. And you said this thing, which really helped him or her.

To you know, made, made them happy, maybe bridge the gap again in this session. So. Sort of helping therapist, you know, connect between different sessions, having a virtual therapist between two different real therapy sessions. So, we are working with hospitals on those kind

of problems. We are working with another set of problems in the metaverse realm, right? Everybody.

Is talking about meta verse and how everybody, now we will all live in the meta verse. I do not know if that will ever happen. But if it does happen, we will interact with these intelligent and yet functional virtual agents. And when I mean intelligent, sure, with the current methods, they will be smart enough to figure out what to do. But would they be emotionally intelligent to figure out what we should do?

You know, looking at people, deciding what to do, what not to do. So, that is where another meta verse, variate problems we are working on. We are working on social robots. Can we deploy these robots in hospital settings, in evacuation settings. Which interact with people.

We are we also have some project with the military, where we, you know, robots are jointly solving tasks with the army. I mean, to do anything jointly, we need to understand human dynamics, human politics. And I do not mean politics in a more broader sense. I mean, politics in decision making, right. So, that is where we think that these kind of intelligent, emotionally intelligent agents, when I mean, agent could be robots, virtual agents, whatever this should might be.

If they are emotionally intelligent, they will be more useful. And a variety of problems or a stem from that that. You know perfect sound. So, I think it. So, I think you used a very interesting word Aniket saying that ok, we are talking about the emotionally intelligent agents, where this agent could be a social robot, this agent.

Yeah.

Could be a virtual character, this agent.

Yes.

Could be like something else as well, a machine may for that matter. So, I believe then many of the learnings that you may be doing in one project. On one type of agent. It can be easily transferred.

Yeah.

To the other type of agent. So, would you like to give an example where you were able to do so or you thought that it is really possible or this can you know may be helpful?

So, yeah, it is a very good, you know, we leverage ideas from one project to the other. And one of the key things, which you know we were discussing earlier that between humanoid like robots, like there is so many robots are there, like the paper robot this which have human like hands, you know human like face. And there is this virtual avatars, virtual characters. So, if I have a motion model representation of human motion.

Like how our hands move, how my body moves, I can put that motion model in either a virtual agent. And however, I have generated using artificial intelligence techniques or other methods, I can use it in robotics problems, as well as graphics problems. So, that is where we leverage, you know, the generation or the motion model aspect of, because human motion is similar, whether you have a real human doing it or a virtual character or a robotic character.

The motion can be transferred to each of these. Agents. Whatever the problem is. Of course, it is a non-trivial problem because robots do not emote in the same way. So, let us say, when if I was, you know, my hands or my expression certain way, if I just copy paste those things onto a robot, will the emotion also translate that that?

That is an unanswered unsolved question. Which I think needs a lot more insights into psych, human psychology to really say, like maybe what looks happy to me, this body language, if I transfer it to some robot, it might look angry.

Yeah.

Then our whole purpose is lost, right.

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So, that, there is a big, sort of so to speak domain gap between, you know, different things. And that has to be dealt separately.

Yeah, perfect, means sounds, I think this is fascinating. And also, since you said, you know, well, I mean, of course, the emotional intelligent part is one thing definitely there. Other thing, for example, you know like if you are trying to transfer the things from one agent to another agent, you also need to look at the physical constraints, I believe.

Yes.

So, for example, maybe you may want to look at the degrees of freedom that.

Yes.

Our social robot may or may not have.

Yes.

Versus the degrees of freedom that, for example, the virtual character has. So, I think then, I believe that definitely it can be really interesting if you can, if you can look at all the constraints, the physical and the emotional, and then optimize the model from one to another thing using the learnings that we have from. Some other project.

That is actually, that is the, the constraints you mentioned are the biggest problems. I mean, it could be worked to advantage as well. But the, like those are, like a robot has significantly less degrees of freedom in most cases.

More humans.

Than humans, right.

Yeah.

And when we transfer some things, if one or two degrees of freedom are lesser or they work differently, the whole emotion can change.

Certainly, exactly.

And we do not know if there is a good mapping between A and B.

Yeah, we do not even know if there is a cultural mapping between two humans, right.

Yeah.

Like I am from India, I am from Delhi, but sometimes when I am meeting people from you know different parts of the world, the way they express their emotion is so different from how I express my emotion.

Yeah.

Right. So, if I put my emotions, my Indian emotions on top of like a Russian man, maybe it will be a completely, you know people might get shocked when the virtual Russian agent, or I am just giving an example it could be really.

Yeah.

Many papers on the world.

Yeah.

Even an American person, like I you know like somebody from South America, we all grow we all grow up in different ways of expressing the same thing.

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If there is a good mapping that needs to be learned, and I think there is a long journey ahead when it comes to mapping between different agents, be it humans, human cultural agents, or even robots and other agents.

Yeah. So, basically, you know, like so there is something, I think definitely you already, maybe have been working on this. So, we already talk about individual variability.

Yes.

But the moment we talk about the individual variability, it could be not only at the individual level, but also at the group level and also.

Yes.

At the cosmic level, I think that is what is.

Yes.

You are trying to refer to.

Yes, yeah.

So.

I mean, sometimes I react differently when I am talking to an Indian person.

Definitely.

Sometimes I react differently when I with somebody else.

Exactly.

So, it is the context sensitive gesture.

Exactly.

It has happened to me unknowingly a lot of number of times. Because I feel maybe that is the comfort space with A and B, but maybe with I am when I am with somebody else, I would react in a different way. So, I guess eventually the whole problem boils down to can I model these things differently? Right now, most people in the world are modeling these things in a very homogenous way.

Yeah.

Like, every human is the same. And I think that is a non scalable thing. I mean, we will never be able to make agents which people can trust. You want trust, you have to relate to that person.

Yeah, and also, I mean, well, I think, you know like so I think, for researchers like you, who are working at the intersection of you know, like this human agent interaction, human

machine interaction. So, you, I believe you need not to look at only at the individual variability of the humans, but definitely as we were talking before.

Yes.

That you are also looking at the individual variability of the agents as well.

Yeah.

Because they may have their own set of variability with respect to the physical constraints that they are in, with respect to the capabilities, with respect to the performance that they have. So, I think that that is that is really interesting. So, I think, you know, now Aniket we will deep down, dig down into one of your very interesting works, which is one also one of your most cited works, which is emotions do not lie. And audiovisual deep fake detection method using affective cues.

So, I believe in this, you presented an approach that simultaneously exploits audio and video modalities and perceive emotions from the two modalities for the deep fake detection. So, I think that is very interesting given, you know, like we already are seeing a lot of deep fakes.

Yeah.

And so the whole idea, I believe, is how can we leverage emotions that can really help you detect that in a better way.

Yeah.

So, please enlighten us about more that what exactly motivated you to address this problem?

So, this was happening, you know this was a few years ago, we started discussing with our students and deep fake was a big problem.

Yeah.

It is still a big very big problem right now. And lot of computer vision researchers are approaching the problem from a very different way. And I and I kept on thinking, and there was that time, I think there was some elections going on in India as well.

Ok.

And we saw some, some deep faked version of I think Lalu Prasad Yadav.

Ok.

Or somebody I do not remember much of. That era, but like and we are like this looks so real you know you can make a politician say anything. And specially in a country like India, where things spread like you know with this technology penetration now, which we did not have many years ago, everybody has smartphones, everybody has WhatsApp, everybody has all of these devices.

If you upload something, even though we figured out that it is fake, and at some point, it spreads like wildflowers. So, it is very.

Yeah.

Critical to detect some deep fakes at the point of spreading.

Yeah.

Right. So, like ok, we need to do something. And I, and we were looking at lot of videos when we found one very interesting thing about the deep fake videos like. And lot of these deep fake videos, their face is being masked by somebody else you know, there was a very big deep fake from, very popular deep fake from Trump saying something and.

Then Obama saying something, and all of these funny you know, voice actors saying all these things. And we found that you know, all of these things are, ok. But the problem is the emotions do not say the same story as what they are trying to say. When the original actor is doing it, of course, the emotion is there because that is the original video.

But when you mask the deep faked face on top of the video, we saw that it does not, something is off about it. It is not everything looks perfect, but the emotions are wrong. And that is ok, maybe what is happening is you know, these models are not able to you know generate the emotions, facial emotions correctly.

So, maybe we can build on top of already existing vision models. We can also build these emotions do not lie, where we are saying that if the emotion of the voice matches the emotion of the visual. Deep faked person or deep for real person, it is likely from a real person. But if it is not matching, there is something wrong about this video. You know I am not saying it is deep fake, but it is likely to be deep faked.

There is already existing other methods are there, which can supplement what we are doing. We are not competing with other methods. We are actually building on top of other methods.

And we saw that in many cases, we got better results. In fact, I think 30, 40 percent more better results than previous state of the yeah, just because we are looking at emotions. So, it was very clear that emotions are very key part of how we can differentiate between what is real and what is not.

That is it, I am sure the next generation of people who make deep fake can build. Emotion into their model. And then our method will become useless. But, like, we are always there to fight with whatever new comes up.

Yeah, and you know I think that that sounds interesting. So, I think, so you know like I would like to know more about this particular work Aniket.

Yeah.

So, for example, can you tell us ok, I understand that ok, this was you wanted to look at the audio visual modalities of this entire.

Yeah.

Deep fake video and you wanted to understand about the emotions. So, can you tell me, for example, let us start from the beginning. Where did you get the data? Like what exactly the data look like in this case?

So, there is a big deep fake data, I think Facebook. Themselves released.

Ok.

A lot of data sets.

Ok.

Of deep fake and non-deep fake datas.

Ok.

So, they are like, people can build classifiers to test and train their algorithms.

Ok.

On.

Ok.

Real as well as deep fake data.

Ok.

And we can generate our own deep fake like there is.

Yeah.

So many algorithms out there.

Yeah.

To generate deep fakes, right. So, obviously, that was the starting point of the data. But we can capture like right now in this fancy room we are sitting in, we can capture very high quality deep fake data.

Which I am I do not know if my method can perform very well, right. You have a very good green screen behind me. You can, I am sure you guys can make me look like an Hollywood star. Rather than a poor professor, right. So, you know, things are getting advanced from a deep fake point of view.

But you know, it is that good old problem of security verse like somebody making a code to, like a hacker versus a security person. Right. They are both are constantly fighting with each other to make sure what is better. Deep fakes are getting scary. I am not going to lie. I mean, we are this paper won a lot of awards from in the state government of Maryland. We I think we won the runner up in the innovation of the year award for this.

But it is it a losing race that we are I do not know; we will constantly fight deep fake. And it is almost personal to me because I feel specially coming from India and that the information spread, the virality of all these things information across social media can be great to reach the masses, but it also could be dangerous.

To make sure wrong information does not, you know you know you have your favorite politician saying some things, excuse me saying some things really terrible. Like, I used to like this guy, what happened? Or you are you know, the person you do not like say something really good. Maybe I will vote for him now. Like before the things actually flagged as deep fake or fake, it has already spread across thousands of media platform.

And we need to nip it in the bud if you really want you know democracy like India. I mean, this is this was almost like I saw that this is really dangerous. If things like this happen, we need to stop it. I mean, of course, there is also a concern for you know women safety when it comes to that you know people post fake pictures of women's faces on top of other you know videos and online you know deep-faking them.

And it is not only like socially very unethical, but it really, you know, puts them in harm's way in many ways. So, we want to make sure that AI is great. We do a lot of generating generative models. You see you seen some of our work. You know, we have seen all the work in this world with really good computer graphics and vision research coming out of this. But we need to make sure that we are using it in the right way.

Deep fake detection is just one of the many problems. I really hope to work more on this problem in the future to compete fight against all the other deep fake methods out there. But yeah, we need expert like you to, you know, work with us.

No, perfect. So, ok, so I think, so, ok so thanks a lot. Thanks a lot Aniket. You know like I can completely agree with it that you know like the deep fake itself has become a big problem, especially in a country where you have like a population of billions you know.

Yes.

Like not we are not talking about millions anymore.

Yeah.

It is not like Europe or even.

Yeah.

Like states but when we are talking about billions and billions of people. So, it is like it can be really, really fatal in many senses, ok. So, let us, while looking at this paper again. So, we understand that, ok, you had this data set, maybe that was released by Facebook and similar data sets where you have a video and then you have corresponding labels as well. So, it is a.

Right.

Supervised learning.

Right.

The problem in that sense. It was already modeled as supervised learning, perfect. And since the video was already given to you. So, you could extract the audio.

Yeah.

And so, you are working on the audio video modalities both, perfect. So, data makes a lot of sense now. And now coming back to the now algorithm part, ok. So, I believe then you may have applied some kind of a fusion architecture or what exactly, how did you bifurcated the audio and the vision modalities separately and how did you make them work together?

So, definitely, we used a fusion architecture for having a joint emotion for the entire spectrum, right you know? So, facial data, text data. Yeah, you know, we have another paper called m3 (Refer Time: 39:32).

Ok.

Where we are combining all these modalities to have a more efficient extraction of emotion. But these individual modalities have their own emotions. Of course, there are many videos where there is contradictory emotion like. Sarcasm, right.

Hm.

Or irony and where what you are saying and what you actually mean, they are very different.

Yeah.

Right? That is Those are for us, outlier cases, we do not know how to handle them, but you know, I am sure in the future, we can figure out a way. Also, sarcasm and irony and all these things are very culture specific.

Yeah.

Very hard to.

Yeah.

You know, when I went to when I went to US the first time, I you know every time I did not understand lot of sarcastic comments, ok, you know, what should I laugh should I? What is happening? Why is everybody laughing and not me, right? So, these are very hard specific culture problem. But apart from that, the hope is that these modalities will have some connections, right. If you are happy or if you are, how do I put this? If you have some anger expressed in your speech.

That anger should have some expression in your facial expression as well, right. So, if you have a joint expression like you look at all cues and you have ok, this person is angry or you know, some anger in there. But you have the voice sort of telling, you know, this, you know I am happy, I am this, no such thing.

If you listen to just the voice, if you could figure out that this is not anger, something else. But if you looked at the face, clearly this is angry, something wrong, you know, this is now there is a big difference in between the anger and happiness.

You know if you see those a little bit so, you know in the emotion spectrum, then like, you are aware of the VAD. The valence arousal. Dominant spectrum.

If they are close enough, you realize that sure, I mean, if there is differences, but they do not have to be exactly the same. But a one points towards fear and the other points about aggressiveness, there is something fundamentally wrong in terms of what you are trying to present.

Yeah.

So, the wider the difference between the modalities, the more like then there is a more chance that it may have been faked. That is all we are trying to trying to predict.

Yeah.

So, in terms of a fusion architectures, like if we looked at everything, then what would be the emotion? Because we humans, we do not look at individual cues, we look at.

Yeah.

I am looking at you and look at the whole of you, right.

Yeah, exactly.

I am not looking at just your face or just your audio. So, when you capture that and then you look at the individual modalities, if there is a discrepancy, it is very easy to find out.

Yeah. So, I think in that, that is case, you know like (Refer Time: 42:05) you rightly said. So, looking at a fusion architecture, and I think the audience will appreciate it also, that looking at the fusion architecture, which could be, you know, we can start with the early fusion or a late fusion.

Yes.

That is another story.

Yeah.

But we really, rather than looking at the each individual modalities as a separate entity.

Yeah.

We really need to look at them in the combination.

Combination.

Perfect. So, I think, you know, that is what the and. So, now, coming back to the last aspect of it. So, for example, while doing this you know like, I believe now you are looking at the emotions and everything. So, what were some of the performance metrics that you are looking at? And how could you. So, of course, you are looking at, ok whether something is deep fake or not. So, essentially, it is a classification problem.

Yeah.

And of course, you are looking at the accuracy and all that.

Yes.

But how exactly were you looking at? (Refer Time: 42:46).

So, its based. So, in many ways, it is, I mean, of course, the classification accuracy is like, if it is classified as a defect, it is a defect which is very binary. So, I think the performance evaluation was, in many ways, this is something we do not did not do completely, but we also wanted to have a perceptual evaluation, right. You know, if humans cannot figure out if it is.

Exactly.

Deep fake versus whether a computer can figure out if it is deep fake, right. And this is where we are kind of struggling at this point. If humans can figure out if it is a deep fake, then there are methods are good enough, you know. We can figure out. But if humans themselves cannot figure out if it is a deep fake, then it is harder because, which means that the emotions are in sync.

So, our metrics our some of the metrics like, you know, how what is the distance, you know, the VAD distance between them. We can threshold them, you know, whatever. The distance.

Yeah.

But at the same time, if the distance is not too much, that does not mean it has not been deep fake. It is a good deep fake behind it, right.

Yeah.

Could be could be. And that is, that has been the biggest challenge. We do not have any good metrics to evaluate that. The deep fake community, I believe is still, I would not say it is an infancy, there is a lot of work in that community. But there is, that it is still a very Boolean operation. Is it a deep fake? Is it not a deep fake?

You know, we do not know how, you know, if there is better ways to evaluate how close it is it to reality or how unclose is it to reality. There are some metrics, but none of them, I think as a community, you know, I am not from the deep fake community, but I think as a community over the next few years, we should, you know, figure out better metrics, better. Benchmarks to figure out whether something is deep fake or not. Because. This is literally going out of hand.

Yeah, yeah and actually, you know, like one thing, as you said. So, usually what we do we when we try to develop the algorithms for the machines, we try to keep the humans performance as a benchmark.

Yeah.

So, if the humans are good at it, machines should also be good at it.

Yeah.

And are the machines performing up to the level of the humans? But frankly speaking, you know, like now we have seen the advancements in the AI in the last. Decade, more importantly, where machines are even performing better than humans.

Yeah.

In many cases. So, for example, I mean, you know, the use case of the image, net and.

Yeah, object recognitions are.

Object recognition.

Much better yeah.

Much better than the humans. Now, of course, you know, some playing also, you know, of go and other.

Yeah.

Other things. And so I, for example, one thing that I really struggle a lot and I believe you may also have encountered the same situation is doing the capture recognition. I mean, it is it has become insanely. You know, when you log into a website and you want to prove that ok, you are not a human. Sometimes it is hard for me.

Yeah.

To prove that I am.

Yeah.

I am.

Yeah.

Human because it.

So, difficult.

So, difficult actually.

Yeah.

And may be machines are becoming better than.

Yeah.

That.

Yeah.

So, I think somehow, I completely agree with you that, you know, while keeping the traditional performance metrics in mind, we need to really look at ok, what is the benchmark that we can.

Yeah.

Keep, which usually is the human benchmark. But while doing so also, I think.

Yeah.

We need to also really understand, maybe keeping humans at the benchmark may or may not be the most viable option also again.

In this case, it may not be because.

Yeah.

Deep fake, right.

Exactly.

If it is harmful if humans cannot figure it out.

Exactly.

Right. And if humans cannot figure out that is where we need to do deep fake detection.

Exactly.

Because that is why like, if I see, it looks good.

Yeah.

But if an AI tells me that, no, this is clearly deep fake. Then we need to figure out, ok, maybe stop it. Yeah.

Because if people can already figure it out, if it is a deep fake, then maybe it is not that harmful.

Yeah.

Again, you and I, you know, we are researchers in this area, we may look at things a little bit more deeply.

Yeah.

But, you know, if this reaches like some rural place in India, then they may not even realize this deep fake.

Yeah.

So, yeah, you are absolutely right that in this case, I think we need to go beyond humans.

Exactly.

Human intelligence, right.

Exactly.

Yeah.

Exactly. So, I would really like the audience to please make a note of it. This you know like, I think usually, of course, while we are talking about the emotionally intelligent machines. So, we like to take these patients from the humans that ok, but I think there are some places where you really need to, you know, look at the common intelligence of the.

Yeah.

Humans rather than intelligence of a single human being maybe.

Yeah.

And I think that is what.

Yeah.

We are talking about.

Absolutely.

Because there is a lot of variability among the humans performance as well.

(Refer Time: 47:02).

Perfect, Aniket sound, I think we are doing really, we are going really well. So, you know, one last question that I have and I think this is really important question, especially for the audience and the young learners in the domain is that you know we already know that

affective computing is a very very interdisciplinary field. And I think you started your talk, discussion with that already, that, you know, this AI with the emotional intelligence, it essentially lies at the intersection of computer science, design.

Yeah.

Psychology and so that becomes really challenging you know to even start working in it.

Right.

And how to address the problems that are there. And I think so, this is where I would like to understand from you that since we have already done a good amount of work and have done for your good for yourself, what exactly are the some of the advices that you would like to offer to a younger colleague who wants to start in this particular domain in effective computing, you know?

Yeah, I think this is the very interesting question. Yeah, I would say when I had started doing my research. Lot of the problems which I had looked into, well this is an interesting problem, let us solve it. You know, this is, we are like trying to figure out human emotion, let us try to figure out human emotion. This will, I think, working on this for some years, you know, we got excited, we did a lot of things, but we did not really think about the end problem in mind.

Like, what is that? This will help solve, ok. We found out that this person looks angry, ok. So, what?

Yeah, exactly.

Agree I think thinking about the problems first and then trying to figure out how well figuring out human intelligence or human emotions or human behavior help solve this problem. If it was, if you are getting 10 percent accuracy, if emotions can be can give another 5 percent

accuracy. So, bringing the human back into the problem, but still keeping the problem as the first point of entry.

I have made this mistakes. I did not, I initially, I did not make keep humans as the point of entry. I thought, just looking at somebody, I can figure out what their emotion is computationally. That idea looked exciting, but what is the end goal for that, right. So, that is why in all of my current projects, I am looking at as I am saying, we are working with doctors.

In fact, one of the problems we are working with actually is the police force. And I am sure you lot of the audience must have heard about this and you know must have written papers that there is a lot of you know in the US specially, police training is a big problem when it comes to understanding different races different. Cultures.

You know, there is always frequent problems with the police. And it is not that every police is necessarily you know against or like bad or you know racist or but they are biased based on their trainings. They only know as much as they have been trained on, right. So, we have actually working with some police departments of how can we train police officers with these virtual characters, which have different cultural components, different emotional components. So, that they do not have to do the training on some videos they have captured.

They can actually interact with interact with police officers, virtual people, you know do all these you know, talk to people from different races, different cultural backgrounds and understand what it feels to be in their shoes, right. So, from a training point of view, working with the military. So, where the end goal is always the key point in mind. And if once that is established, you know, this is the good problem. Let us try to solve it. Then try to bring in the human component.

And I am sure as time progresses, this is the very very interdisciplinary field you know we were just talking about this 10 you know an hour ago that, natural language processing you

know that is also a very important player in this affective computer because language is a lot, it conveys a lot of emotions, language.

Conveys a lot of behaviors. So, NLP, robotics, psychology, psychiatry, I mean, computer science in general like AI, obviously, but all of these fields have heavily influenced each other in this affective computing realm. So, even if you are working in robotics, or you are working on some other field, if you are in the department of psychology or from a medical point of view, think about the affective computing, think about what, how would it help the problems you already have.

As you know, like we you know, we start like our work was always in this robotic simulations or graphics. And initially I did not do any emotion, but as we started from crowds to a. So, looking at crowds is looking at things in a macroscopic way. But then when we start to look at, you know crowds are only crowds because of the individual people in it and the individual people all have emotions, all have their own behaviors.

Start looking inwards, then we realize how important emotions is, how important human behaviors is. How important cultures are. And start to model them for different applications. Yeah. So, as you know you know, initially you were asking how can new researchers in this field sort of, you know, do great or like do very interesting, you know solve interesting problems in this. I think just look at problems in your own domain and then try to bring the human in the (Refer Time: 52:13) and then realize that there is hundreds of problems which we can solve.

Ok, perfect, perfect, ok, So, I think thanks a lot Aniket you know like I believe of course, we can keep on going on taking the knowledge from you in this domain for a longer time. But I believe given the time that we have and the scope that we have, I would like to thank you for your time.

Thank you.

And I believe the audience definitely will find it very very useful. And I will encourage the audience, please go through his labs work and some of his most fascinating research works. And if you have more doubts about it, I am pretty sure Aniket will be more than happy to take the doubts from you over E-mail and feel free to contact him for any purpose.

Thank you.