UNIVERSITY OF MINNESOTA

"Tech Talk" TV Show Season 4

Robotics

Drawings of robotic devices appear. From 1495 1738, 1927, 1962, 1968, 1987, and 1977. Lastly a video of a robot toy is seen.

Susan: Hello and welcome to Tech Talk from the University of Minnesota, your source of information about the technology that surrounds us every day. I'm your host, Susan McKinnell. For hundreds of years people have been dreaming up machines to make life easier. Not all of these schemes have worked, however, and some of them have had unexpected results. But today, robots are doing more work than ever before and their taking on some unusual forms. Our first guest today is Professor Maria Gini. Maria is Morse-Alumni Distinguished Teaching Professor of Computer Science at the University of Minnesota. She teaches courses on computer programming, artificial intelligence and robotics. She is currently doing research on distributed robotics and medical language. But today, she's here to introduce us to a little friend. Maria, thank you for joining us.

Maria: Well, it's fun to be here.

Susan: What is robotics?

Maria: Well, it's a field of science and engineering and I think what is fascinating is the mixture of engineering—you have to build something—a robot is a physical body.

Susan: Absolutely.

Maria: So you know, plastic, mechanical…

Susan: Metal.

Maria: Yes, metal, all sorts of things. It also has programs. Because to be a robot; you have to get something that can do different things.

Susan: So it has to be programmed just like a computer is programmed.

Maria: Exactly, exactly. The other thing that kind of makes a robot different from a lot of other things that we build is that they have to be autonomous. They have to be able to decide on their own what to do.

Susan: It's almost like they have their own little brain.

Maria: Right! And often people use the term artificial intelligence when they talk about robotics because you want to make the robots to be intelligent. Maybe not as smart as we are but, to be capable of…

Susan: Not quite as smart as us, but

Maria: Maybe in the future, who knows? But they have to make decisions that make sense to us because if they don't then we say, "Oh this is a dumb robot. It doesn't do anything good."

Susan: Absolutely. So, is that the main thing that is required for a mechanical program/object to be a robot, is that it is autonomous?

Maria: In general, that's…every definition has some controversy. Not everybody agrees. But in general is this notion of autonomy. Now, autonomy doesn't mean they have to do everything on their own. They can get input from users; they can interact with a person. So maybe like the robot is in a difficult situation and it doesn't know what to do and it maybe can get some help from a human being.

Susan: In some ways that may even be more like a human. You have problems? Ask for directions.

Maria: Exactly, but they need to have enough ability to things on its own. Otherwise, it's not a robot.

Susan: Absolutely. What sorts of things have traditionally been used for robots? What have robots helped us with?

Maria: Most of the robots are used for manufacturing or like welding, spray painting.

Susan: When I think of is things in the auto industry, in particular.

Maria: Exactly. Where there are jobs that are very dangerous environments where it's not really good for people. So robots have really taken over. Again, spray painting and welding which are again, heavy, difficult operations they are always done by robots.

Susan: Absolutely.

Maria: Now, there are robots also going outside the factories. I mean as long as they are in the factories people say, "I don't care much. They don't affect my life unless maybe I lost my job."

Susan: Which is obviously…

Maria: A big thing. But now they are getting out of the factories. Now you start seeing, you know, robots being used by the police departments to defuse mines.

Susan: That seems like something that I would rather have a robot than a person do. The Minneapolis police department does that.

Maria: Yes, they have those.

Susan: Fabulous.

Maria: And those are the kind of robots that are mostly manually operated so they are not too autonomous. But they are enough autonomous…

Susan: So, they're kind of remote controlled?

Maria: Almost, yeah, right. But you know this kind of job is so hard it's really good to have a machine. If the machine blows up, that's a lot of money.

Susan: You lose a machine.

Maria: But it's not personal. Exactly!

Susan: So it seems like there is a fine line between something that might be a remote controlled machine and then something that might actually be a robot and depending on the level of…

Maria: It depends on it's own applications and people call the entire set and they say those are all robots and people say there are different levels of autonomy and if you have some autonomy, just if the robots can turn the motors, you send the command and you say, "move" and it goes.

Susan: So then that's described as autonomy.

Maria: Right it's autonomy because I don't tell it exactly how much to turn or that the voltage has to go to the motors and so on. I just give it a high level command.

Susan: Okay.

Maria: So there is some autonomy even at that level. But in general, people like to see more. So as people we would like to get to the point where we can give very high-level commands to robots, or ideally, want to talk.

Susan: It makes it easier for us everyday people to say, "Go do that" and not have to say, "You need to do this and this and this…"

Maria: Exactly. That is why we would really like to have some ways of interacting with them which is verbal, not by typing, if it's possible not to have to give commands with a keyboard.

Susan: Or a joystick?

Maria: Or a joystick or something else and we would like also to be able to interact with them so if the robot is doing something strange we can scream, "Come on! Stop!" But, this is not he case today. But this is what we'd like to do.

Susan: That's where we want to go with this.

Maria: Yeah.

Susan: What sort of things are robots being used for right now?

Maria: In practical applications, there are a number of applications, again, in factories, like the autonomous kind of way. You know the parts move in the factory on those kind of carts. Those are sorts of robots, they are not fully, fully flexible. There is the Roomba that everybody uses.

Susan: I've heard plenty about the Roomba. The commercial is all over the place.

Maria: It's making the life of a lot of women easy.

Susan: And some men too.

Maria: Men too.

Susan: For folks that are unfamiliar with the Roomba, can you tell me a little bit about it?

Maria: Well, it's a very small device that is a robot. So, you put it down in a room and it goes around on its own, very slowly and picks up dust. And you go to work, come home, you pick it up, dump the dust and put it back and the next day it's going to do the same thing.

Susan: It's a high-tech vacuum cleaner, really. Now you say small device, and I think traditionally too, some people think of robots, you know, you have the sci-fi picture of a robot that really is a humanoid figure with the moving arms and a Roomba does not look like this at all.

Maria: No! It looks like a dish, it's small with a very low height and kind of round. It looks sort of like a vacuum cleaner. And the only thing it really does is to vacuum floors. It doesn't do…

Susan: That one task.

Maria: One task, but it does it well and I can take it to my home and put it down and it vacuums my house. I give it to you, and you take it to your house, it does it there.

Susan: Even though my house looks completely different.

Maria: Exactly.

Susan: It has dust in different places.

Maria: Exactly. Maybe you have a cat or a dog or whatever and it adapts to the environment. It has some sensors and some algorithms so it can decide how to go around and adapt to the room. That's what kind of makes it autonomous.

Susan: Now what about, I've heard a little about companion robots.

Maria: Yeah. This is another area that is becoming more and more interesting because as the technology has developed now we can have robots that are much smaller. You know those big, monster kind of butler robot that you know is two meters high and kind of scares you off?

Susan: The scary ones.

Maria: Right. Those are out. We don't want anything that looks scary.

Susan: No, we want friendly robots.

Maria: Exactly. Smaller! We are not scared of things that are small. Like, for example, there is a very interesting project in Japan in which they built a robot which is a baby seal. And his fur is very soft to the touch. It doesn't do much, because what do you expect a baby seal to do?

Susan: I have no idea what baby seals do.

Maria: I have no idea either, but they have a nice face.

Susan: It's a very friendly…it's a Paro, right?

Maria: Right, that's a Paro.

Susan: And they have very friendly look, it is very fuzzy and cuddly.

Maria: Yes, big dark eyes. When they open the eyes and look at you, you can't do anything bad to them. Right? You feel like, "Oh I cannot harm this!"

Susan: Are they used then therapeutically?

Maria: Yes. They're used in Japan in some nursing homes to help elderly people to get engaged. Because, you know, often one problem is that people are not engaged enough.

Susan: Yes.

Maria: And so they use them there. There is also an experiment they are doing with autistic children. Again, the issue is how to engage someone in a way that is not threatening.

Susan: Absolutely. Autistic people frequently are threatened by motions from people.

Maria: Yeah. So there are a couple of projects. One project I know is in Italy and one project is in Sweden and then there is one in Japan with the same kind of idea.

Susan: Now, I want to take a look at the robot you brought here today.

Maria: Oh! I brought in my small dog.

Susan: Okay, can we turn in on?

Maria: Sure!

Susan: Not that you normally turn on a dog.

Maria: Right, but this is a special dog. This is a commercial product from Sony made for entertainment. They sold a number of dogs. They have been out for maybe six years with different models. This is last year's model.

Susan: There we go. Hey there. Hi there.

Maria: You can touch it.

Susan: It doesn't feel much like a dog but my goodness it's very refined in it's movement.

Maria: And now we're going to see him start to…

Susan: This is really for entertainment value. You say that they sell…what are they going for?

Maria: They go for a little less than two thousand dollars, around nineteen hundred.

Susan: Not an inexpensive bit of entertainment, but yeah. And so I know we have some toys here.

Maria: Yeah, it's going to see…it's going to get up. It's like, in a sense, like a real dog. You have to be a little patient. I cannot tell it exactly what to do.

Susan: Well, you mentioned that robots have to be autonomous.

Maria: It thinks he sees his bone and they get attracted and try to go there. You could try to put it a little bit closer and see.

Susan: What do you think of that? Oh my goodness.

Maria: As you see the toy has a specific color here. So the program in the robot is designed to recognize this kind of dark pink color so it makes it a little bit easier to find.

Susan: So that the dog knows exactly what to look for.

Maria: Yep. Good dog! Good dog! And we can kind of tell he is doing fine. He likes it. He is very happy. And you say, "Good dog."

Susan: Now, you don't use this for, obviously, you have some fun with this guy but he's not really a toy for you, is he?

Maria: No, it's not a toy, that's a good point. In fact we are using this as part of teaching. It forces, in a sense, the students to look first at entire things. When we develop technology, we cannot think only of one piece. We have to see the big picture. And here, everything is here. You have the hardware, you have the wireless, and you have a camera.

Susan: There is a camera in there?

Maria: There is a camera in the nose. It's kind of a funny place. But in general it makes the dog to lift up the head.

Susan: Like dogs do when they are looking at you, absolutely.

Maria: And they have also, some software here to try to look for faces of people.

Susan: I'll just turn it here so it can face the camera.

Maria: So it tries to find out the face of people. It points it head in the direction of the voice. So a lot of those things are already built in. Because it has a computer it is a memory stick like the ones you put in the cameras.

Susan: Okay.

Maria: It has a program. So you put the memory stick into the belly of the robot and then it does whatever the program does. So for computer science it is a very good combination that requires a lot of skills. So we're going to use this starting next year for an introductory course in computer science. Just to expose people.

Susan: And what do are your students going to be doing? Other than playing with the dog.

Maria: No, no, no. They will do serious work.

Susan: Absolutely.

Maria: Now that we learn how to start programming it in a simple way with some kind of scripting language that kind of gives commands.

Susan: So even though the dog already comes with programs you can create your own programs for the dog.

Maria: Exactly. Yes. We can create the programs and then we can make the dog do different things.

Susan: That sounds like a wonderful way to get new students involved.

Maria: Exactly. And because this is so cute I think this is going to help bring in people that in general think that computer science is cold, hard and kind of for people who have no social skills. It's just kind of a stereotype.

Susan: Yes.

Maria: And every time you bring in a dog like this, you know, lots of people come around.

Susan: It really attracts people.

Maria: Exactly.

Susan: This was attracting all of our staff before we got started. Maria, thank you so much for being with us today.

Maria: It was fun being here, thanks.

Susan: The Aibo is certainly fun but the Roomba robot has already been voted most popular. It is not as friendly as an Aibo but it does concentrate on one task, cleaning the floor, and it does a pretty good job. And with more than one million Roombas sold it's the most successful home robot ever made. Our next guest is Professor Nikos Pappanikolopolous. Nikos is the Director for the Center of Distributed Robotics at the University of Minnesota. He's been a professor at the U for 13 years where he teaches and does research on computer vision, artificial intelligence and robotic systems. And he too, has brought something for show and tell. Thank you for being here, Nikos.

Nikos: My pleasure.

Susan: What have you brought for us to look at?

Nikos: Let me start with…

Susan: That doesn't look very…well,

Nikos: What do you think it is?

Susan: Well, it's kind of hmm. It looks kind of like it's slapped together.

Nikos: No. We call it the Scout 2000.

Susan: I see it's got a little Goldy on it. That's very nice.

Nikos: It's just the antennas.

Susan: Okay and what exactly is this?

Nikos: So this is a robot that we developed seven or eight years ago. And we have several Scouts variances, we call them. And its main purpose its surveillance, reconnaissance. For example, whenever you have an earthquake or search and rescue missions you send this tiny device. This is like a soda can.

Susan: It looks smaller than a soda can.

Nikos: So it has a tiny camera.

Susan: Way over on this side. Am I right on that? I'm looking at the wrong spot.

Nikos: Here, is the camera.

Susan: There is the little camera.

Nikos: And there are multiple other sensors. The goal here is just to collect information and transmit this information wirelessly…

Susan: Absolutely.

Nikos: to a human operator.

Susan: So you could send this somewhere where a person couldn't go.

Nikos: Or you can throw it.

Susan: Or throw it?

Nikos: Through a window.

Susan: It doesn't look that tough. I hate to say it, but. This isn't the actual model that you're using right now is it?

Nikos: No, no.

Susan: This is just a prototype?

Nikos: This has evolved into something that's a little bit more solid with respect to the throwing.

Susan: Okay. Let's take a look at what you're using right now.

Nikos: So, this is what we call the COTS Scout.

Susan: COTS stands for?

Nikos: Commodity-Off-The-Shelf Scout. It looks ominous. What do you think?

Susan: It does! It looks a little scary. Of course, you know, we all think of scary robots…I think of scary robots when I think of robots. I've probably read too much science fiction.

Nikos: Reminds me of my daughters. They are scared when they see this stuff. So the idea here is we have a device made out of titanium and aluminum with these interesting wheels in order to master a variety of terrains.

Susan: Okay, so titanium, so this is pretty tough.

Nikos: This is. You can go over it with a truck. It has a camera.

Susan: Just like the prototype version right there.

Nikos: The tail, in order to stabilize it.

Susan: Okay.

Nikos: And then you can send it almost anywhere you know, to collect information. For example, imagine that you have a fire, if you want to find human survivors you can send it in and then you can use a pyro-electric sensor in order to find, to sense, body heat.

Susan: Pyro-electric?

Nikos: Yep. These, essentially, we use to detect human presence and then we can transmit this information to the firefighter. So,

Susan: So they know exactly where to go, there is less risk to the firefighter, and obviously you could find the person in there a lot faster if you know exactly where they are. You said you could have different kinds of sensors on these.

Nikos: Yeah, you can have ultraviolet sensors, in other words, light sensors. So, we can sense lights or we can sense dark spots. We can have head sensors, we can have cameras, we can have microphones, we can even have meteorological or chemical agent sensors.

Susan: Okay, they could test for things that are not safe for people to be in.

Nikos: Exactly.

Susan: I know that you've done lots of tests on how tough this is, and one of the things you did was through this into, what was it, a parking ramp on the U of M campus?

Nikos: A parking ramp, so we picked one of our best throwers—a graduate student and we threw the scout to the fourth floor and then the robot, controlled by the human operator was able to go close to the car, inspect the car and then transmit the images and the information back to the human operator.

Susan: Fabulous. About what sort of range is there between the device and the human operator.

Nikos: It depends on the environment. For example, indoors; we're talking about a hundred feet, outdoors; line of sight is probably 300 to 400 feet.

Susan: It's a good range.

Nikos: But you have to consider the fact that this device operates very close to the ground. So this is a major obstacle.

Susan: So if there are any little bumps in the terrain then it's going to have a harder time getting that signal.

Nikos: Also, if you have a lot of steel in your building or you're in an indoor environment, this affects the whole performance.

Susan: Yeah, absolutely. Now, I was talking earlier with Maria about autonomous—how robots have to be at least somewhat autonomous in order to be a robot. Now you said there is a human operator involved. We just saw that. It looks a little bit like it's a remote control device, but there is some autonomy involved here as well.

Nikos: There is some autonomy, for example, this device can find a dark spot, follow a wall, so on and so forth. But always we want the human to be the ultimate decision maker, I wouldn't ask the robot.

Susan: I think that makes it a very important factor there.

Nikos: At this point.

Susan: At this point. Is that because…

Nikos: You see, their processing power is very limited here. Also they don't really have the cognitive capabilities embedded into this device.

Susan: This is a pretty simple computer we're talking about.

Nikos: Yeah, we're talking about a 16 megahertz processor.

Susan: 16 megahertz, that's…yeah.

Nikos: It is probably 15 or 20 years ago.

Susan: Yes, yes. Much slower than what we're having in our home computer.

Nikos: Yep.

Susan: So, therefore it's better to keep the decision making on the human end of things.

Nikos: Always. I mean, we view this as assistive technology.

Susan: Okay.

Nikos: We take the human as far as possible into danger or from the action and then we provide all the necessary information to the human. I think this is where the real value for this device is and the real application is.

Susan: Fabulous! Now we saw the demo on video, but I'd like to see a live demo. Can we do that here?

Nikos: You bet!

Susan: Am I being a little brave here?

Nikos: Yeah! Let's…what I'm going to do is, I'm going to pull.

Susan: And what does that do?

Nikos: This activates it.

Susan: So it's not really on until you pull that. That's the on switch.

Nikos: So, this is the on switch so it is very simple. And then what we're going to do is I'm actually going to… this is what we call the operator control unit. This is a regular TV monitor. I'm trying to tune it to the appropriate signal.

Susan: Absolutely. So, it's using a wireless signal to go from…to get the camera image from the robot to your remote there. And now…now it's moving!

Nikos: Oh! We lost it!

Susan: Right off the table. Oh, now wait a second. And we're getting a different view of the studio here. That's a pretty good signal there. I can really…now, I'm not sure if our home viewers can tell too much. I'm a little more familiar with…It's the underside of the table. I'm a little more familiar with the studio than probably our home viewers, but…That's amazing!

Nikos: Yeah. It's pretty amazing the stuff you can do when you blend science, engineering, artificial intelligence, mechanical engineering even psychology and perception. I mean we try to invent, for example, the basic notion of how we can perceive things, how we can sense things how can we interpret this information, how we can get this information back to the end user.

Susan: That's a lot of expertise that went into this. What are some of the limitations? We talked a little bit about how the wireless signal can be hard to get, you know, depending on where it's at.

Nikos: The toughest is the communications, as I mentioned earlier. Another interesting challenge to overcome is power. These devices can operate for 90 minutes roughly.

Susan: Do they have a battery in there?

Nikos: They have a lithium polymer battery which is pretty standard for these devices but you would like to have the ability to operate for days.

Susan: Yes. Ninety minutes is not too long.

Nikos: Yep. So this is one area where we are really short.

Susan: Now you mentioned how important those wheels were, that they could go in multiple terrains. Was that a really difficult thing to develop?

Nikos: Yeah because, for example, we went and we tested different polyurethanes and different materials to find the right material, the right configuration in order to survive the impact. We drop it, for example, forty, fifty, sixty feet you have to be real cognizant of all these aspects. But furthermore, the biggest challenge, the way we view it as a group is, “How can we integrate thousands of these devices?” Let’s say we deploy forty or fifty hundred of these devices how can we integrate the information seamlessly.

Susan: So, not just the individual feeds from each camera but really figuring out the big picture.

Nikos: Yeah, our expertise is what we call distributed robotics. So imagine that you have thousands of ears, noses, eyes out there and you try to collect information. So, how can we do this effectively?

Susan: Now, wait a second, this sounds to me like we might be getting into a discussion of some sort of privacy issues and concerns about that.

Nikos: Yeah, actually this is a major issue. Whenever you talk about cameras, audio sensors, and with the proliferation of cameras these days privacy is a major issue. And I don’t think our society has the laws and the infrastructure to address this proliferation.

Susan: It’s something that we haven’t figured out with our laws yet.

Nikos: Yeah, I mean for example there are cultural issues, certain cultures wouldn’t accept these devices taking snaps, for example, of faces, or I wouldn’t like to have a device like this when I try to purchase clothes or when I try to buy things, goods at the supermarket.

Susan: And I suppose there might be commercial applications of something like this would follow our purchasing style and that might not be something that I’d like to have people doing.

Nikos: Yes, indeed. And that’s, as a society, we need to think of different ways that we can really integrate these devices which are extremely powerful, into our whole set of laws and what is publicly acceptable or is not.

Susan: Absolutely. What direction is robotics going? Just briefly.

Nikos: It’s a tough one. But what I foresee in the next few years is just that we are going to see many, many devices. For example, assistive devices taking care of the elderly or taking the vital signs of humans trapped or used by police or by firefighters or used by the military.

Susan: The kind of thing that has maybe one or two, at the most, functions—limited functions, or limited jobs.

Nikos: Robotics are very effective whenever we have a well defined task. We cannot expect that we can have a robot that will be able to solve all the problems.

Susan: We need to have something fairly clear for it to do.

Nikos: That's right. It's like the Roomba that you mentioned earlier. The Roomba is very successful because it does something very, very specific; cleaning the floor from dust.

Susan: Absolutely. Thank you so much, Nikos. It's been a pleasure talking to you.

Nikos: It's my pleasure.

Susan: We hope you've enjoyed our crash course on robotics. We covered a lot of new territory, so here is a quick review for your files.

Susan VO: Maria Gini, professor of computer science and electrical engineering at the University of Minnesota described robotics.

Maria: It's a field of science and engineering and I think what is fascinating is the mixture of engineering; you have to build something. A robot is a physical body. So you know, plastic, mechanical.

Susan: Metal.

Maria: Yes, metal; all sorts of things. Also, it has programs because to be a robot you have to get something to do different things.

Susan VO: Maria said that most people expect robots to be able to make at least some decisions.

Maria: Often people talk about Artificial Intelligence when they talk about robotics. Because you want to make the robots be intelligent. You know, they have to make decisions that make sense to us because if they don't, then we say, "Oh this is a dumb robot. It doesn't do anything good."

Susan VO: Nikos Pappanikolopolous, professor of computer science and engineering said even though robots are getting more and more advanced, they shouldn't be left without human guidance.

Nikos: There is some autonomy, for example, this device can find a dark spot, follow a wall, so on and so forth. But always we want the human to be the ultimate decision maker, I wouldn't ask the robot.

Susan VO: Nikos also said that the purpose of surveillance robots is to protect humans.

Nikos: we view this as assistive technology in other words we keep it human as far as possible from the danger or the action. And then we provide all the necessary information to the human and I see this as where the real value for this device is.

Susan VO: Remember that archived scripts and video files are always available on our website techtalk.umn.edu. Be sure to tune in next week. We'll be learning all about medical technology. From pacemakers to pulse generators, people are relying more and more on technology to keep themselves healthy. Until then, I am Susan McKinnell.

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