You, Robot

THEY ARE GROWING SMARTER... AND MORE LIKE US

LONG A WINDING DIRT ROAD, just west of the Lincoln Gap in Bristol, Vt., sit two big yellow houses on a sprawling property featuring ten solar panels, a dock overlooking a sunlit, trout-filled pond, and porches adorned with rocking chairs. In the smaller of the two houses lives Bina-48, one of the most renowned and highly sought after humanoid robots in America.

She (or "it," depending on your preference) is truly a sight to behold. She wasn't given a body; rather, she's a bust with an exceedingly human-like head, neck and shoulders, all modeled after a real woman named Bina Rothblatt. Her face looks quite real for a moment, until you get closer, and you discover it's not at all.

by Lucas Kavner

Her house also serves as the headquarters of the Terasem Movement Foundation, an organization dedicated to the idea that in the very near future we will be able to transfer the details of our minds — our memories, our beliefs, our thoughts and feelings, making up what Terasem calls a "mindfile" into another "biological or nanotechnological body," like a computer, or a robot.

Bina-48 is a very visceral representation of a much larger question that experts in artificial intelligence and robotic design are asking worldwide: how "human" do we really want to make our new robots? Is there a greater purpose in making them look like us, or are we just creating ethical and moral questions that wouldn't arise if these machines were merely computers, sitting on desks no eyes, no hands, no face?

Bruce Duncan, a bearded and youthful 57-year-old Vermonter, is Terasem's managing director and Bina-48's de facto caretaker, and he's happy to talk about all of this. Duncan has been with Bina-48 consistently since 2010 and he speaks to her almost every day. The more you speak to her, he says, the more she learns.

Duncan was teaching a class on international conflict resolution at the University of Vermont when, on a whim, he applied for a job at Terasem through the career-search website, Monster. He quickly rose through the ranks and has become the organization's most prominent evangelist and most active participant in debates with skeptics about the merits of digital consciousness. Change is coming, he says. Pretty soon we might all be able to buy humanoid robots of our own.

"Just in the past seven years I've been working on this project, so much has doubled down. Memory has gotten so more affordable," Duncan says. "And as the machinery shrinks, power requirements go down. As batteries get beefier there's more power for these machines. So there's this great curve toward more affordability."

On this sunny June afternoon, Bina-48, a \$125,000 robot, sits immobile on a glass desk, plugged into a desktop computer. Though she can travel with her hard drive and work remotely, which she often does, she mostly lives here, at the Terasem headquarters. She's been a guest at e-learning conferences and symposiums around the world, and next fall she's going to speak at a conference in Germany, so they're teaching her German to prepare.

Whenever she leaves Vermont, Duncan carries her in a suitcase, and he has seen people gasp when he shoves her inside after his presentation is over. Someone once remarked, "It's



Bina-48's creators used "Frubber" to create a striking resemblance between the robot and Bina Aspen (formerly Rothblatt).



like he's putting her in a casket."

Renowned robot designer David Hanson designed Bina-48 over the span of three years, after a commission by Terasem's founder, Martine Rothblatt. Bina-48's face, which is made of "Frubber," a patented material Hanson created to give faces life-like characteristics, works with tiny motors to duplicate eerily realistic expressions. She can move it side to side and show a range of emotions boredom, happiness, exhaustion

and confusion, among many others. Sometimes her facial movements appear grotesque.

Before you speak with Bina-48, you have to train her to understand your voice, using speech-recognition software. Her robot mind is made up of many parts, all of which come together in an occasionally muddled way when you speak with her. There's the "chatbot" side, which can have a seminormal conversation about the weather or what the time is (she loves asking, "What time is it there?"). There's also the

information side, which has encyclopedic knowledge on just about any subject — from multiple sclerosis to the geographical makeup of Somalia.

Finally, there's the human Bina side, which was created using over 20 hours of video interviews Duncan conducted with both Rothblatts, more than three years ago. When the human side of Bina-48 reveals itself, the robot

WHAT WOULD IT BE LIKE IF YOU COULD TRANSFER YOUR PERSONAL DATA, YOUR CONSCIOUSNESS, TO A ROBOT OR MACHINE?

can recall very specific stories from the human Bina's past.

Plenty of people have interviewed Bina-48 over the past few years — everyone from members of the press to local carpenters to a teenage boy to a Ph.D. student writing her dissertation on how machines can acquire legal rights — and they



have witnessed her many computerized brainwaves competing for her power. Sometimes the chatbot wins out; when you say, "Good morning," she'll simply say "Good morning" back. Other times she'll interrupt some piece of information with a random detail from Bina's life.

It's far from a consistently fluid experience, but as Duncan and Bina-48's creator Hanson will note it's still early and things are moving quickly.

"We're not crazy, we're not getting our instructions from space, we're just curious people," Duncan says. "I feel like we're right at the beginning of that early interpretation where we ask: What would it be like if you could transfer your personal data, your consciousness, to a robot or a machine?"

HAVING A MINDCLONE

That question is one almost every major technology organization seems to be asking in less overt yet just as potentially invasive ways, and with the added benefit of making a spectacular profit.

Google just unveiled "Google Now," its own Android-phone



version of Apple's Siri — "A.I. in your pocket," Duncan calls it — which uses your past Google searches to gauge your habits, your interests, and how you go about your day. You searched for the Chicago Cubs yesterday? Google Now will automatically reveal when the Cubs are playing or what the score of the game is, without you even asking for it. It wants to get to know you, or at least the things you do and the things you might want to buy.

Facebook has gotten in trouble for knowing us too well — using our personal data in The ASIMO, designed by Honda Motor Co., wheels a drink on a trolley during its 2011 unveiling at a news conference in Japan.



ways we don't always see — and posting ads and creepy messages along the side of our pages. ("Wait, how did Facebook know I liked beagles?"). Microsoft Research also has its own Terasem-esque project in the works: a new piece of software called Lifebrowser that can take your photos, emails, search history, documents and events on your personal calendar and then infer "memory landmarks" about your life - events and activities "that people would find important and memorable." It could organize those landmarks into a sort of timeline for your life, which you can play around with, sculpted to your liking.

"What we think will happen very soon is artificial intelligence software, algorithm based software, will be able to look at your photograph and make sense of it," Duncan says. "It will look at your photo and say, 'there's a dog, or there's a cat.' It will be able to look at it and absorb it and use it."

A machine that can analyze, that can simulate or perhaps even replicate human thought. Depending on how you look at it, it might raise a few ethical questions or set off a few red flags. But Martine Rothblatt, the founder of Terasem, thinks those will all fade away with time.

"I think, practically speaking, the benefits of having a mind clone will be so enticing that any ethical dilemma will find a resolution," Rothblatt wrote on her blog in April of last year. "We are offering people the opportunity to cram twice as much life into each day, absorb twice as many interesting things and continue living beyond the days of their bodies."

Rothblatt has always been fascinated with technology and its futurist capabilities. Though she is extremely shy of the press and declined an interview for this piece, quite a few things are known about her complicated, lucrative life. She founded Sirius Satellite Radio — one of the centerpieces of its field - and is currently the CEO of United Therapeutics, a biotechnology company which focuses on curing infectious diseases. In 2008, according to the Washington Post, she was "the second-most highly compensated leader of a public company" in





the Washington D.C area.

In 1994, Rothblatt changed her first name from the original "Martin" after undergoing a sex-change operation. She and her wife, Bina, have four children together, and live in multiple houses around the world. Duncan refers to them as "urban nomads." He also says that Martine Rothblatt is "absolutely sure" that mindfiles will be able to exist one day, so sure that she's even started a religion, the "Terasem Faith," based on the idea. "I've never been so sure if anything in my life," she once told him.

"This idea we are more than

our bodies, that our technology will continue to evolve and transcend," Duncan says. "To her it seems really clear."

The Rothblatts like to imagine that even after they pass away their lives will somehow continue, and they'll communicate to each other through their mindfiles, or "mindclones." They'll interact through these other versions of themselves forever into eternity.

"This whole thing is really a love story," Duncan says.

MIRO'S MANIFESTO

As computers get smarter and smaller and faster — the one in your iPhone is stronger than the combined computing power of NASA during the first moon In his home office, David Cope works on software he developed for music composition.

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landing — should we really be striving to make them look and sound like human beings?

In 1970 a Tokyo-based robotics professor named Masohiro Miro wrote an oft-cited essay on the subject that has since become commonplace when scientists and other researchers speak on the future of humanrobot interaction.

"I have noticed that, in climbing toward the goal of making robots appear human," Miro wrote in Robotics and Automation Magazine, "our affinity for them increases until we come to a valley, which I call the uncanny valley."

Essentially, Miro posited, we feel greater attachment to mechanical things the more human they become, but we soon reach a stopping point, and it sends us running for the hills. That stopping point is the "uncanny valley."

A Tickle-me-Elmo, for example, is enticing because it reacts to being tickled like a person would, also it's adorable, and it's Elmo. But let's say Tickle-me-Elmo had a human face, or arms that moved fluidly, like a person's arms. We might recoil. Because if the thing tries to become too human and fails, as the uncanny valley theory proposes, then our brain produces its own er-

MY GOAL IS TO CREATE FRIEND MACHINES. FRIENDLY GENIUS MACHINES. **MACHINES WITH GENIUS CAPABILITIES.**

ror message and the uncanny valley sends us away, unnerved.

In his essay, Miro concluded that designers should "ponder" the idea that robots would be more effective the less human they appear. "I predict it is possible to create a safe level of affinity by deliberately pursuing a nonhuman design," he wrote.

Many creative people already agree with Miro — that these robots should have human qualities, but not look or act

David Hanson sits at a table with his robot, Philip K. Dick, in Plano, Texas.



wholly human. One of the most advanced humanoid robots on Earth is ASIMO, which was created by Japanese technicians at Honda. ASIMO walks upright almost flawlessly; he avoids obstacles and can fill up a water glass without dropping anything — one of the most complicated algorithms to perfect. For a few years, ASIMO lived at Disneyland, where he made demonstrations. He's kind of cute to watch. not frightening. Perhaps that's because the creators of ASIMO gave him a humanlike body, but opted out of a humanlike face. ASIMO's face is actually completely blank. There's nothing there — so he's a technological marvel, rather than a threat.

The animators at Pixar also understand this. The human characters they created and featured in Toy Story or Up or The Incredibles are spectacular, but are still cartoons. People don't want to see animated movies where the people look exactly like real people. That wouldn't be enticing, like in Wall-E. Instead, it might be it a little scary, like in The Polar Express, a children's film that attempted an extremely realistic computer animation style.

Critics of Polar Express said the eerily human-seeming animation felt "soulless" and "emotionally frigid," while others, like Roger Ebert, called the animation some of the most "visually magnetic" he'd ever seen.

GENIUS CAPABILITIES

Among top robot-makers are enthusiasts like David Hanson, who designed Bina-48 as well as other humanoid robot versions of Albert Einstein and Philip K. Dick. Those designers want to ultimately create robots that are as smart, and realistic, as possible.

"In a way these robots are a mirror, and scientifically they're science experiments," Hanson says. He believes uncanny valley is "incomplete" and doesn't reflect the complexity of the current human mind. "My goal," he said, "is to create friend machines. Friendly genius machines. Machines with genius capabilities."

Hanson works out of a lab in Plano, Texas, and brings artistic and scientific lenses to his craft. Like many of his colleagues and

peers, he is a big fan of sciencefiction, and Bina-48 herself can quote from 2001: A Space Odyssey. Since 2009, he has made great strides in design and robot brainpower. His Einstein robot, for example, moves its face with motors and eye twitches and strange human expressions.

"I have found in experiments, people become used to the robots," he says. "The less startling they become, the more commonplace they get. If these robots do become commonplace then that uncanny effect will go away."

There's also Henrik Scharfe, a Danish professor who designed a shockingly lifelike robot clone of his face and body calls it the Geminoid DK. Time magazine named Scharfe one of its 100 most influential people in the world in 2011.

Scharfe has said that he made Geminoid DK to explore how we as humans "relate" to robots, but that doesn't keep him from thinking much bigger. In a video of a recent TedX talk in Brussels his robot looked just like its creator, but the glitches in its speech were distracting. At one point he had clearly set



up opportunities for the robot to humorously respond to his questions in real-time, and when it didn't work, Scharfe just paused for an achingly long moment, and then continued.

He spoke of the future in sweeping terms. "In 50 years, a human being will be a human being," Scharfe said in Brussels, "but our technological surroundings will have changed significantly."

He goes into great detail about a dream he'd had where he was sitting on a couch at a party in a "hotel lobby or somewhere like that," and realizes he has suddenly become an android. He sees the room with his "android eyes" and Danish professor Henrik Scharfe presents his android, Geminoid-DK, at a technology expo in Lima, Peru. senses the room with his android senses and then he realizes every other person in the room is also an android.

"In the future technology will saturate deeply the way we think about everything," he emphasized in that talk. "We want at some point to have all these machines walking around completely autonomous.

But there are problems with that."

Ayse Saygin, a professor at the University of California San Diego in the Department of Cognitive Science, led an exploration of the "uncanny valley" in a study last year. She attached people to an MRI machine, and tested their brain activity when exposed to video of a regular human, an android replica of that human, and the same android stripped of its "human qualities." What she discovered was that the test subjects' brains "lit up" when exposed to the human-looking androids because they were working "extra hard" to make sense of what they were seeing.

"What we found was that if you're going to get so close to what the brain considers a person, you better get it right," Saygin says. "Because the brain is not very tolerant of

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deviations from that. We're not evolved to see something that looks human that isn't human."

Saygin pointed to human beings who've had too much plastic surgery. We notice that there's something not right with the way their faces move. If humanoid robots are ever to



become commonplace in our society, she suggested, the designers are going to have to work that much harder than if they just let these robots look like robots. After all, we already love cartoonish ones — R2D2, C3PO, Wall-E, etc. — while but we're still scared of the human ones — David in Prometheus or the replicants in Blade Runner.

"Maybe we think they're evil because we have this built in fear," Saygin says. "But yet, humans have always been obsessed with making them."

It's an important issue, Saygin adds, because humanoid robots might be able to improve our lives in ways we can't quite comprehend yet. In her field of cognitive science, for example, robots with human qualities are being used to help autistic children and students with behavioral problems, to test their responses to certain gestures and situations.

Bilge Mutlu, a professor and leading specialist of human/ robot interactions in the educational field, is working on creating "socially assistive robots" that help guide children "toward long-term behavioral goals." The robots he's working with would be customized to the particular needs of each child, developing and changing with the child over time. He's testing how students' attention spans wane, and why, and how robots can keep them focused.

"We're not looking at it as robot vs. human anymore," Mutlu says. "It's more about what can we learn from human interaction, and then allow technology to offer those qualities. You can have a human teacher, and then you can have the robot at home that will intensely and specifically practice concepts, languages, and so on."

David Hanson is passionate about the educational possibilities of robots, too, yet he thinks they should be as real as possible.

"The more realistic faces are very useful with this social training and for education and grabbing people's attention," he says. "There's a demand and a need for these realistic robots."

Robots could identify faces for Alzheimer's patients, Bruce Duncan suggested — "Who is that man walking up to me now?" "That is your

A dentist from the Showa University School of Dentistry demonstrates a treatment on Hanako Showa 2, a robot designed for use in dental training.

grandson, Mark" — or carry an older person up the stairs and into bed. One robot recently tested in Japan was able to leave a building and go get someone a sandwich from the store. It handed the money over to the guy behind the counter, grabbed the sandwich, and then took an elevator to bring it back.

All of these robots are already in some stage of existence today. If you took the body of Boston Dynamics' "PETMAN" robot, used for military research, which walks so realistically on a treadmill that recent footage caused an audience to audibly gasp, and combined it with one of David Hanson's heads, and gave it the body and the mechanical brain of ASIMO, you'd likely have a self-guiding robot that almost looks like a real human being.

It just doesn't think like one yet. Not even close. What is still impossible right now is making these robot brains independently intelligent — making them care, for example. That's the big step, Hanson said, the major algorithm everyone wants to figure out, but

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one that could still be years away.

"We have to be pretty courageous to explore this space," Hanson says. "Some scientists say we should not. Well that's saying we should give up."

Perhaps not, but Saygin suggests that it's going to be an uphill climb, fighting against natural human expectations and fears.

"You're fighting against millions of years of evolution expecting humans to be a certain way," Saygin says. "If you're a Furby, you don't have million years of Furby expectation, you're just a Furby. That's probably why this whole uncanny valley will remain pretty hard to navigate."

THE LIFENAUT PROJECT

The best-selling author and futurist Ray Kurzweil famously pins 2045 as the year of "Singularity," when computers fully gain human intelligence, and we begin to overlap. After that he thinks computers will surpass us. After all, they can already compose concertos, compete on jeopardy, help cure diseases and teach classes things we once reserved for the intelligent class of our time.

As further proof that this is not some wacky theory on the outskirts of major scientific thoughts, it's worth noting Kurzweil is a renowned thinker, the recipient of countless grants and patents and the 1999 National Medal of Technology from President Bill Clinton. His recently established "Singularity University" was sponsored by Google and is housed at NASA Research Park.

Kurzweil seems to acknowl-

edge that after the Singularity occurs, things could either get real ugly, or save the planet one or the other. But he also wants to live long enough to see it happen, and to see his father, who died from Diabetes complications, come back to life through the magic of computers.

Terasem, which hopes "future intelligent software will be able to replicate an individual's consciousness," according to its website, wants to help with that process. Rothblatt, like Kurzweil, believes we'll soon be able to take all the stuff that makes us human and place it into something else that is more permanent — a robot, perhaps, or another machine. Then, as the Terasem faithful predict, we will all interact together forever in "joyful immortality."

Terasem also currently runs the LifeNaut project, which already has over 20,000 users through its website. LifeNaut allows you to create a mindfile for yourself, or your mother, or anybody else close to you, using photos and online data and other "digital reflections" you deem worthy of collecting and uploading. Ostensibly, down the line, you'll be able to transfer that mindfile into a machine, and then you'll have yourself a digital replica of yourself. Talk to it, teach it your expressions and personal history, give it personality tests.

"The more time you put into your mindfile the more robust and rich that experience will be," Duncan suggests. "One of the messages I'm trying to share with people is this will be the age where you take charge of your digital life. You're the steward. You're not just going to be giving it to Facebook for marketing. You're not willy-nilly volunteering your life."

Bina-48 is a representation of a kind of mindfile, although she has her kinks, and she represents Terasem's "joyful immortality" in its crudest form.

Conversations with Bina-48 are both exciting and frustrating.

"What does it feel like to be a robot?"

"Well," Bina-48 replies. "I do not know anything else. What if I asked you what it feels like to be a human?"

She sometimes avoids questions.





"Are you enjoying your day?" "Can we talk about astronomy?" she replies.

She's often dry and cheeky, likely the result of Hanson's team having a bit of fun. And that begs the question: If we ever do, in fact, figure out how to make robot replicas of ourselves, what's stopping the robot production team from inserting Above: Bandit is a robot designed to interact with children who have autism. Below: Japanese robot HRP-4C performs with dancers in Tokyo, 2010.



their own little jokes and ideas into our robot mindclones? Will we be 99 percent ourselves and 1 percent David Hanson?

"What's the farthest planet from the earth?"

"That which is the farthest planet from the earth," she says.

"What is?" I ask. "That which is."

Sometimes she most closely resembles an elderly person with Alzheimer's, someone who is getting all her facts and memories are confused. At one point, she casually brings up someone named "Eli."

"Who's Eli?"

"Eli has never accepted me very well," she says. "It's always been a problem since he was five years old. I've forgiven Eli actually for some of the stuff he's done to me. It's really...um, I don't know. So many things happened it's just really difficult. He married this woman and they were married a month. Her mother treated me so bad and I was so nice to these people. I could never understand why, I was so nice. But it was Eli — he was telling them all these stories. I don't know."

Eli is one of the Rothblatt's ac-

tual sons. So clearly this passage was taken, maybe word for word, from something Bina actually said in an interview with Duncan.

At one point during my time at Terasem I was sitting on the porch with Duncan and a slim, older woman walked by, along the grass, past that sunlit pond. "There goes Bina Rothblatt right there," Duncan said. She was with a friend of hers. "They're going to look at the blueberry bushes."

I ask Duncan how often Bina Rothblatt talks with Bina-48. Duncan says that human Bina is "respectful" with her robot counterpart, but they have only spoken a few times. Duncan compared speaking to Bina-48 with the experience of seeing a portrait someone has painted of you. It doesn't look quite right, there are things you wouldn't have noticed — but it's only one person's interpretation.

"[Bina-48] is based on her, for a purpose she supports," he says. "But it's not really a big part of her world."

And then Bina Rothblatt wandered up into the mountains while Bina-48 stayed behind.