

Now Reconfiguring Reality

Reconfiguring Reality



Optimizing values with design choices

What Does Your Spoon Stand For?

by Sarah Smith and Jessica Cussins

The idea of technology as morally neutral is pervasive. We are told that it is only the use of a technology that makes it good or bad. But, technology is persuasive. It is designed with optimal users and purposes in mind. It exerts influence over our lives and helps create the kind of world we inhabit.

The spoon is one of humankind's earliest technological inventions, and seems about as neutral as it gets. Is it really?

From Power to Convenience

Spoons have actually been used to signify wealth, power, and religious significance for thousands of years. Although many early spoons were made from wood, which was cheaper and easier to carve, spoons were also made of silver and gold to distinguish the wealthy and elite. Spoons engraved with hieroglyphics were used for religious purposes in Egypt some three thousand years ago. British kings were given spoons ceremonially, and spoons of varying degrees of preciousness were often given as christening gifts, probably resulting in the phrase, "born with a silver spoon in his/her mouth." In other words, the material, design, and ceremony surrounding the spoon have made it not just a tool, but also a signifier of class, religion, ability, and social status. But these values are not necessarily constant.

Fast forward centuries and the plastic spoon

gained prominence in the 1950's in an ode to a value of a different kind: convenience. However, as concerns about climate change and sustainability have grown in recent years, compostable cutlery has also grown in popularity. Other shifts are more imaginative or subversive. For example, it is not uncommon to see people playing spoons as a musical instrument in folk bands.

But what a spoon has been capable of to date has been fairly limited. The technologies of the Internet of Actions is transforming even the humble spoon into an object that can be re-imagined and designed to optimize for a wide set of values.

The convergence of additional technologies possible today however is changing what is possible in every space, and cutlery is no different. So-called smart spoons, embedded with computing power, are now available and add additional layers of ability to these items we use daily. The range of design possibilities is expanding, and the choices we make are a reflection of the values we hold today.

Bringing different values to a technology, even when that technology is as simple as a spoon, has a meaningful impact in the world. The idea of design ethics is to think critically about what a design is optimized for, who it is intended to benefit, and in what way. Many digital technologies are optimized to encourage time spent on a company's service. But this is rarely in the interest of the user. What other kinds of values are being explored within the space of our eating tools? The following signals highlight how prioritizing different values can alter the impact of a technology. They also encourage us to test our assumptions about the objects we use everyday.

Dignity and Independence

The company Liftware (now called Verily) has designed "smart spoons" that are self-stabilizing, which helps people who struggle to hold food steady for a variety of reasons to eat with greater ease. Liftware became part of Google Life Sciences (now called Verily) in 2014. The company's first product, Liftware Steady, allows someone with a hand tremor, for example from Parkinson's disease, to eat more easily. Liftware Level helps people with limited hand or arm mobility, for example from cerebral palsy, spinal cord injury, or Huntington's disease, to eat more easily. The spoon is electronic and uses a microchip and sensors to respond to the hand's movements.

While online reviews reveal that the product does not work for everyone, it does seem to improve the experience at least to some degree for many others. Although using a special set of utensils can be stigmatizing in its own way, Liftware empowers people to feed themselves without spilling food. It also enables its users to do things many of us take for granted, like go out for dinner with friends without feeling stigmatized. It is designed to be discreet and to minimize the stress and embarrassment of spilling one's food. This design helps people with reduced motor function to regain some of the dignity and independence that comes from being able to eat on one's own.

Mindful Health

Unlike Liftware, which aims to increase the ease of eating, the HAPIfork aims to make it a little more challenging. The purpose of this, is to cause you to eat slower, which is beneficial according to the company because it can improve digestion and support weight control. Using HAPIfork is supposed to help you “lose weight, feel great!” The HAPIfork uses lights and vibrations to alert you when you are eating too quickly. It also tracks your eating habits: the amount of time you spent eating and how much you ate, which you can then monitor on its website.

Another company called Spün Utensils, claims to calculate the nutritional information in the food you eat, and offer you “as much (or as little) data on your eating habits as you'd like.” It also provides nutritional recommendations. It works through the use of motion sensors and by weighing each bite of food. Similar to the HAPIfork, it also uses vibrations to alert you if you are eating too quickly, as well as if you have reached your calorie goal.

A slight twist on these ideas, an “electric flavoring fork” announced last year by Hiromi Nakamura at the Rekimoto Lab in Japan, tricks your taste buds. The fork uses a small amount of electricity to stimulate the tongue and generate the sensation of eating something salty. The product is currently targeted at those who need a low or zero salt diet, such as hypertensive patients.

Safety and Security

In 2014, the Chinese search giant Baidu unveiled a set of “smart chopsticks” that can check for contaminated cooking oil. There is an illegal

practice in China of reselling so-called “gutter oil” that is toxic and harmful, but can end up in your food. These chopsticks, called Kuaisou, apparently started off as “something of an April Fool's prank” according to a Baidu representative, but were met with real interest.

It is unclear if this product ever made it to market, and it is hardly the most straightforward strategy for shutting down dangerous and illegal activity. Nonetheless, it's a nice idea that your eating utensils can keep an eye out for you, so to speak, and warn you if the food you are about to eat is unsafe. Baidu representatives also talked about future versions being able to tell the origin of different ingredients and the nutrition they contain.

Novelty and Fun

Not all ideas for eating utensils have such lofty goals in mind. The so-called “selfie spoon” unveiled by cereal brand Cinnamon Toast Crunch is pretty much what it sounds like. It is a free spoon people can order with an attached selfie stick that allows people to photograph themselves during breakfast. Their website states, “Selfies and cereal together at last!” and assures this is, “Really a Thing!” It's a brilliant marketing ploy to get kids to advertise cereal. It's fun to use the device, which is now sold out.

So What?

Each of these individual products is far from perfect. A recent study published in the journal *Appetite* actually found that the HAPIfork made people eat slightly slower, but made no difference on the total amount they ate. Moreover, when people experience a device like this as “food shaming,” they may avoid using it, or it could even backfire. Any particular technology may be the wrong place for a value to be expressed, and good intentions can certainly go awry.

Nonetheless, all technologies are value-laden. Uncovering those values, and thinking critically about what you actually want from them opens up new opportunities. As the simple technologies around us—from spoons to everything else—become increasingly infused with algorithms and intentions, the question of what values to encode and how to overcome biases will become more difficult to ignore. Over the next decade, we'll program machines with a much wider set of goals, priorities, and values, and they will be much more effective at achieving their ends.

Metaphors to expand possibilities

What Lies Beyond the Virtual Assistant?

by Dylan Hendricks

The age of the intelligent agent is upon us, but the true consequences of their emergence remain largely unexplored. Is Siri just another genre of software interface, or do the technological offspring of Alexa and Google Now portend much broader transformations to our workforces, bureaucracies, and social institutions? To fully grasp the nascent possibilities of our digital helpers, we must first expand the metaphors we employ to make sense of them. What lies beyond the “virtual assistant,” toiling away at our driving directions and calendar schedules, and just how will tomorrow’s intelligent agents break through the silicon ceiling to realize their potential?

We’ve identified five algorithmically enhanced roles that companies and institutions of all sizes should prepare to engage with in the coming decade. The future for intelligent agents is so bright, Alexa may need to dim the smart lights and order herself a new pair of shades.

1. The Surrogate: Your Digital Clone Army

Virtual assistants may help lighten the burden of daily logistics, but offer no reprieve to the fundamental constraint on productivity: time in the day. The surrogate promises to chip away at that historic obstacle by formally representing your interests and making decisions on your behalf.

Ray Dalio, the CEO of the world’s largest hedge fund, has tasked his researchers at Bridgewater with creating an intelligent agent that can reliably apply his personal principles to the firm’s decision-making process: hiring and firing workers, pursuing investments, and navigating internal conflicts. Replika represents another early foray in this direction, crafting your algorithmic doppelgänger by mining text chat conversations.

Why you may want to work with the Surrogate: What better way to broaden your empire or extend the reach of your brand than employing a small army of digital clones for product pitches, contract negotiations, and press junkets?

Why you may be wary: With the proliferation of personal data online, there’s little to stop third parties from creating Surrogates without consent, unleashing an army of impostors to spearhead fraudulent schemes or competitive ventures.

2. The Consultant: The Efficiency Czar That Never Sleeps

There’s nothing that intelligent agents understand so well as the goals and functions of logical systems. For companies not proactively developing their own artificial intelligence (AI) applications, a visit from the Consultant may represent the most obvious strategic investment of the next decade: assessing processes, identifying efficiencies, and laying the groundwork for the introduction of their algorithmic peers.

Urban planners in the cities of Pittsburgh and Hangzhou have already experienced the benefits of algorithmic consulting in their traffic grids, enjoying 25 percent fewer traffic snarls with intelligently directed traffic lights. Google similarly discovered 40 percent reductions in data centers cooling costs by enlisting the help of their own DeepMind program. Meanwhile, JP Morgan Chase and Japan’s Fukoku Mutual Life corporation have begun outsourcing the vetting and auditing of customer contracts to high-speed algorithmic bureaucrats.

Why you may want to work with the Consultant: As the landscape of intelligent agents evolves, Consultants won’t offer strategic differentiators so much as helping maintain minimum viability in an AI-rich world.

Why you may be wary: As the lore of the intelligent Consultant grows, the algorithmic snake oil salesmen won't be far behind, offering fantastical outcomes that are often too ambitious to be realized but too compelling to completely ignored.

3. The Ambassador: Brokering Relationships We Didn't Know We Had

While humans in the near future may spend more of their time interacting with bots, intelligent agents will also play a growing role in helping us communicate with each other. For bridging cultural gaps, or aiding large multi-stakeholder efforts, you will find no moderator as patient or objective as the intelligent Ambassador.

Beyond the impressive language-translation technologies recently developed by Microsoft, Google, and others, Kore is developing bots that can translate the goals and context of large enterprise systems for regular people. The Swedish AI firm Gagai AB has taken this one step further by announcing a plan to create dolphin-to-English translation capabilities by leveraging an extensive database of recorded dolphin sounds.

Why you may want to work with the Ambassador: As corporations become more global in their reach, the importance of nuanced cross-cultural communication has never been more important, both inside the company and out.

Why you may be wary: To date, subtle social cues have not been intelligent agents' strong suit. While this is likely to change over time, intelligent agents will need a few more years to grow out of their socially awkward phase.

4. The Detective: Connecting the Dots a Million Times a Second

The mythos of the private detective has loomed large in western culture for many decades, investigating personal infidelities and burning shoe leather on open-ended mysteries. In the near future, hiring intelligent Detectives to solve life's complex riddles may become as second-nature as looking up trivia on Google and Wikipedia.

A Baidu-produced AI system in Chongqing recently reunited a family with their long-lost son by algorithmically aging his boyhood face and identifying him as an adult among thousands of hours of video surveillance footage. The Emma Identity project uses natural language

processing to identify works written by the same authors based on subtle patterns in their writing—to the detriment of would-be plagiarists. In the UK, police have embarked on an algorithmic project called VALCRI to analyze crime scene data and suggest plausible hypotheses.

Why you may want to work with the Detective: It's your personal private eye, minus the chain-smoking and cynical one-liners.

Why you may be wary: Machine learning systems often produce correct results that can't be explained in human-understandable terms. Even if you know who committed the crime, the inscrutability of the Detective's algorithmic evidence trail may pose legal dilemmas with no easy solutions.

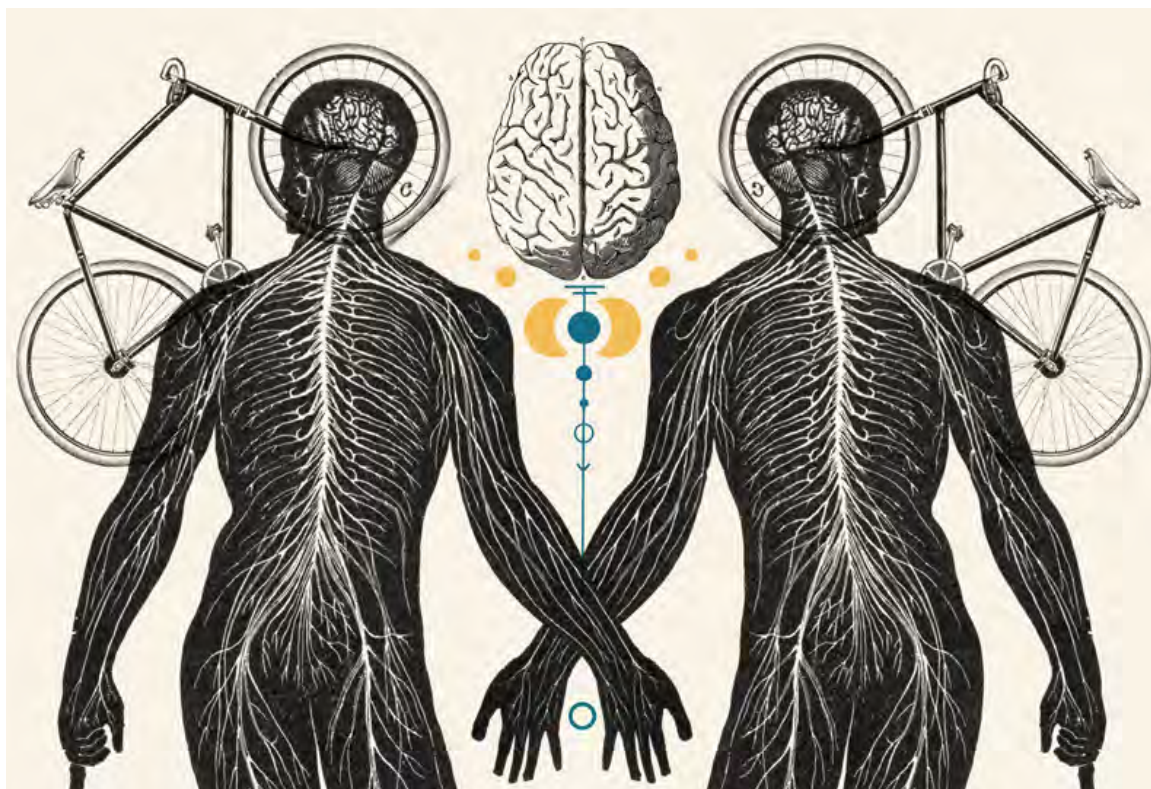
5. The Oracle: Digital Prophet or Internet-Connected Ouija Board?

At IFTF we always say, "No one can predict the future." But what if intelligent agents can? The Oracle promises to question our innate assumptions by making bold predictions based on vast data sets and the hidden patterns within them. We'll likely never understand the basis for these predictions, but that won't always stop them from being accurate.

Researchers at the Illinois Institute of Technology have proposed a machine-learning framework for predicting Supreme Court decisions based on the language used in proceedings, while the UK's Medical Research Council is pursuing an AI framework for predicting when hearts will fail from ambient data sources. Scouring satellite data, Descartes Labs recently announced a project to predict global food shortages well before they happen.

Why you may want to work with the Oracle: In this hyper-competitive, hyper-global world, every conceivable edge makes a difference. Everyone's appetite for eccentricity is sure to increase if the Oracle's projections for future demand and conditions are right even some of the time.

Why you may be wary: The stock market has already demonstrated how quickly algorithmic decision-makers can be spooked by erroneous data. As our faith in the Oracle's mysterious power grows, the implications of faulty conclusions become more dire.



Embodying Avatars

Researchers Saadia Khan and John Black have pioneered what they call “surrogate embodied cognition,” having students use avatars in virtual worlds to enhance learning. Though the students are only manipulating an avatar on a screen, because they identify with the avatar, they imagine themselves physically moving which, neuroscience shows, activates the same parts of the brain as if the students were actually moving in real life. Going forward, we could see the “surrogate” removed from the techniques pioneered for “surrogate embodied cognition” as students go from controlling avatars with their hands to moving through virtual space with their whole bodies.

Understanding Unconscious Aspects of Mastery

Oftentimes, when an experienced performer in any given craft is trying to describe to a novice the process of executing a task they have mastery over, they are not consciously aware of some of their most important actions. But full-body capture technology could reveal some of these

techniques. For instance, the creators of a specialized set of eye-tracking glasses conducted a study that mapped where a master pianist looks when they are playing a piano as a way of better understanding the unconscious activities that master practitioners engage in. Going forward, machines will increasingly track not just our movements and conscious expressions, but also track things our body is doing that we might not be aware of, uncovering new insights into the learning process.

Rewiring the Brain

Researchers at Duke University conducted an experiment using VR to help paraplegics control robotic exoskeleton legs. After the study ended, researchers were surprised to discover that seven out of eight of their paraplegic subjects (who had been using VR mostly to train the brain-computer interface to the robotic legs) had actually begun to regain motor control of their real legs. This points to the potential to use VR to actually rewire neural pathways in the human body, opening opportunities for learning that we can scarcely begin to conceive.

Your New Telepresence Superpowers

Get ready for your robotic upgrade

by Carla Sinclair

Thuc Vu, CEO and Co-founder of the Silicon Valley startup OhmniLabs, says his favorite thing to do with a telepresence robot is to cook with his grandmother. She is teaching him how to prepare Vietnamese dishes he enjoyed as a child. He lives in the United States while she lives in Vietnam, but with the Ohmni robot that his company makes, “It’s the closest thing to being there in person without physically being there.” The 35-year-old entrepreneur says that from his house in California he steers the Segway-shaped robot, which sports a large display screen, around his grandmother’s kitchen. There he can “poke my camera into the different ingredients, pots, and pans and ask her questions.” His grandmother can pour, mix, and add ingredients hands free, without holding a phone or tablet to talk to him, “so it becomes much more of a rich, engaging interaction versus just sitting in front of Skype.” With the growing popularity of telepresence robots, the telecommunication network is evolving into a “teleaction” network. Meaning long-distance communication is moving beyond a merely verbal or textual conversation (phone, email, text) into the broader communicative realm of shared experiences. And with lighter weight, less expensive robots coming onto the market, we can expect to see more telepresence robots not only in corporate, government, and academic institutions, but also in private homes.

Currently, telepresence robots are still in their infancy. Yes, an out-of-town mother can play hide-and-seek with her daughter at home, a physical therapist can show her long-distance dad how to do stretches for his strained back, and a person can save a life by calling 9-1-1 after virtually checking in on an older relative and finding him unconscious (real examples). But these robots are limited. They have wheels instead of legs, so stairs are a problem, and they don’t have arms, so doing chores, pushing an elevator button, or simply waving hello is out of the question. However, telepresence robots are quickly evolving with more human-like capabilities that will enable a richer experience for everyone involved. Here are three examples of robotic upgrades we can expect to see in the near future:

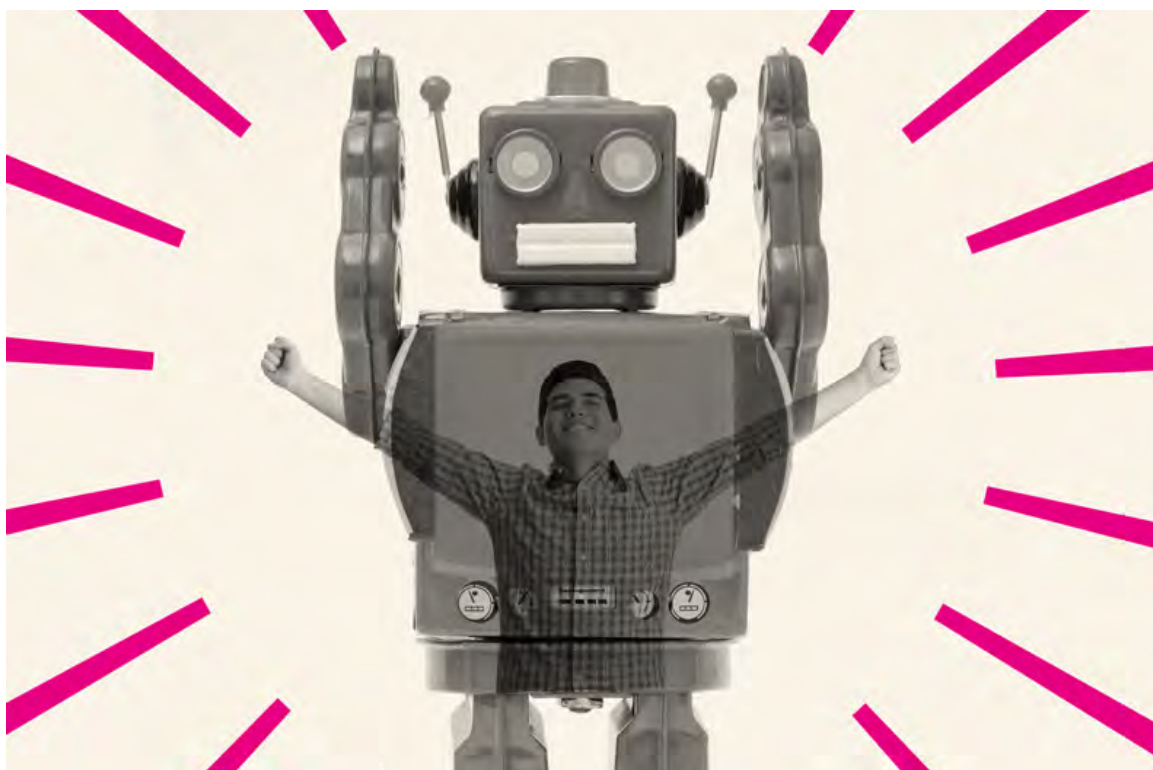
1. See and Hear Like a Superhero

Right now a tutor beaming into a student’s house might strain her eyes to read the algebra worksheet. And an employee beaming into the office might have trouble hearing what the boss is saying if the office is competing with outside noise. But Sutable Technologies, who makes the telepresence Beam Robot in Palo Alto, CA, launched some prototypes this year with improvements to both hearing and vision.

“We have a telepresence robot that’ll have super senses,” says Bo Preising, the company’s Chief Strategy and Product Officer. Preising says these audio and visual “super senses” should be on the market in the next year or two.

One improvement will include their pan-tilt-zoom camera, which allows the robot’s head to move up and down to match the eye level of those around it. “The pan-tilt-zoom is like your eyeball,” says Preising. “If your head is stationary, you can move your eyes around ... and then the extra feature, which human vision doesn’t really do so well, is ... you can zoom in on something far across the room, like 20 feet away, and actually be able to read a business card.” Imagine how helpful supervision will be for someone looking at documents at a virtual business meeting, or a long-distance caregiver looking at lesions on a patient’s skin.

Robots will also have a better audio system with noise cancellation so that people can hear with more clarity. “We have an array of microphones that can get rid of all the extra noise in the room,” says Preising. “If you imagine yourself in a situation where you’ve got a jackhammer



outside of the house, our microphones can delete that noise so you'll be able to hear what's going on in the room better than people who are actually in the room." As for people actually in the room, they will be able to hear the person driving the robot with more clarity than anything currently on the market.

2. Pick Up Faraway Objects

Arms for telepresence robots are already a reality, but they're not available to consumers—yet. Suitable Technologies has robotic arms at the company that can manipulate objects and pick things up off the floor. But, according to Preising, "They are still very expensive for most people," and the user interface is still a bit challenging.

To accelerate the development and affordability of the arm, OhmniLabs has invited developers from around the world to brainstorm with them as part of an open-source community collaboration. "The ability to pick up an object is a key capability we are working on," says Vu. "We are working on a lightweight but also affordable and highly capable arm to allow the robot to pick up and manipulate objects in the real world." Vu says that it's absolutely possible to achieve this in five years.

3. Chip in With Housework, Rosie the Robot Style

There's an episode of *The Jetson's* in which Rosie, the robot maid, lights up a cigar for Mr. Spacely (George's boss) with a lighter that is built right into her hand. That's the idea behind robots that can do chores. OhmniLabs is brainstorming about ways to build a robot that can vacuum, clean the dishes, and do laundry.

Thinking outside the box, Vu says that rather than have the robot use its "hand" to pick up a tool such as a scrub brush, the robot would have built-in (or attachable) tools. "Instead of having the robot pick up a vacuum cleaner and move it around the home, we can build the vacuum right into the robot, in the base."

So if your college kid runs out of the house after leaving a pile of dishes in the sink, you'll be able to tell him to march right over to his laptop or smartphone and clean up his mess. And maybe you can even hang out with him in the kitchen while he's at it.

While Preising pragmatically says this is something that might be available in 15-30 years, Vu says that he could see a housekeeping telepresence robot, like the robotic arm, ready in five years.

Teaching Robots How to Work Together

A conversation with
swarm robotics pioneer

Nora Ayanian

Interview by
Mike Liebhold, Mark Frauenfelder, David Pescovitz

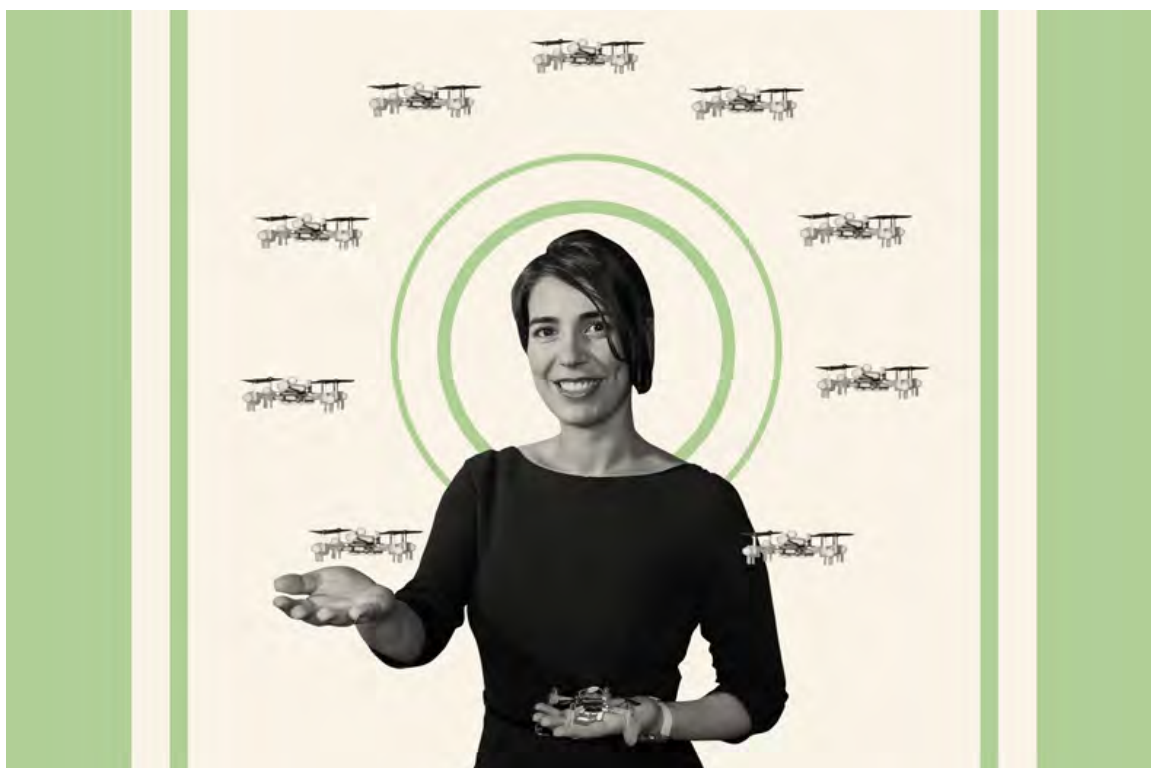
In a video created by the Automatic Coordination of Teams Lab at the University of Southern California, a set of 49 drones line the floor of an empty studio. They lift off in synch, never breaking the shape of a perfect square, and proceed to soar, dive, and twirl like synchronized swimmers. Then, suddenly, they break formation and rearrange into the letters U-S-C. This demonstration appears, on the surface, similar to the one put on at this year's Super Bowl. But the small size of the robots, the precision of their coordinated movements, and their ability to navigate indoors represent substantial breakthroughs. And the future applications of this technology extend far beyond entertaining spectacle. Multi-robot coordination could revolutionize everything from farming to disaster response. IFTF caught up with the Lab's director, Nora Ayanian, recently named one of MIT's top 35 visionaries under 35, to get her perspective on where this could all go in the next decade.

Your drones fly in beautifully coordinated, synchronized ways. How you are able to achieve this?

We were able to get 49 small [drones] flying together, which is, to my knowledge, the first time that's been done indoors, basically by using an external motion capture system to determine where the robots actually are and then relay that info back to the individual drones to help them navigate. A majority of the computation is actually done on board. The drones get information about their location from the server that is running the motion capture system, but the updates are not frequent enough for stable flight since there are so many drones and so few radios. So we fuse information from their on-board accelerometers with the updates from the motion capture system.

What about the robots' behavior? It seems reminiscent of a school of fish or birds.

In terms of the large groups of robots moving in synch, that may be. And there are people in robotics that study the movement of birds and fish. But those animals don't do the things that I want my systems to be able to do. I work normally on smaller groups of robots where we have specific tasks that we want them to accomplish and they are not all doing the same thing ... I was thinking about how these robots could be better and asked, "Why is nobody studying how people interact with each other?" If you've ever worked in a group with others, we usually allocate tasks based on people's skills. Tactics like this can be used by robots as well. And the nice thing about humans is that you can ask them, "How did you determine that you should do this and the other person should do that?" And they'll actually answer. That's how I got to one of the problems that I'm working on now: How do you learn from human coordination in order to get robots to coordinate better? For example, we want to learn how diversity helps humans solve complicated problems, so that we can allow robots to take advantage of diversity in teams as well. We are also interested in how humans solve problems that robots encounter, with only the sensor information that robots would have. By working on these projects, we hope to get teams of robots out of the lab and into the real world, doing things like environmental monitoring and precision agriculture.



Are there practical applications of multi-robot coordination that are mainstream today?

Absolutely. It's been used in manufacturing for a long time and in warehousing. That's how you get your packages in two days or less. They've basically turned the warehousing paradigm upside down. Instead of people going and picking the packages off of the shelves, the shelves actually come to the people—each of the shelves is carried over by a robot. Multi-robot systems are also working in mining, so there's lots of these systems at work today; it's just that not everybody knows about all of them.

Where is this going? What does a future of abundant computing power mean for your work?

It means a robot can operate without external influence. It can make decisions, take large stacks of data and figure out what they mean, and decide what to do. There is certainly a limitation now—anything that requires a large amount of data analysis is impossible to do on board for some of the robots, especially the flying ones. The ability to do more on board means that they can be more self-sufficient and rely on the cloud less or use the cloud in a more interesting way—for example, instead of using it to crunch data a robot needs on its own, the cloud can be used to share information across robots, to get informa-

tion that's available online, such as maps and geophysical data, or to exchange information with other connected devices, like mobile phones.

What else do you see as changing in meaningful ways?

I think that having a unified way of interacting with these devices might be the most interesting change. Right now, everything has its own specific mode of interaction, communication, and operation. Over time those will all, potentially, merge into some standard, where we all interact with these devices in the same ways. And that will lead to a lot more innovation in what these devices can do. We really only touch the tip of the iceberg in what multi-robot systems can do today.

What would this world look like? What could you imagine in the next decade?

I imagine a world that's like *The Jetsons*, where we have robots all around us and they are not necessarily part of one multi-robot system, but instead, there are multiple different systems of robots. There are big problems that we can make a huge impact on—like saving lives by containing or putting out forest fires or search and rescue. But they will also just make our lives a lot easier. One day having Rosie the Robot will be kind of normal.

The Rise of Computational Propaganda

A conversation
with IFTF Fellow for Good

Sam Woolley

Interview by Mark Frauenfelder

On January 17, 2014, Girl 4 Trump USA joined Twitter. She was silent for a week, but on January 24, she suddenly got busy, posting an average of 1,289 tweets a day, many of which were in support of U.S. President Donald Trump. By the time Twitter figured out that Girl 4 Trump USA was a bot, “she” had tweeted 34,800 times. Twitter deleted the account, along with a large number of other Twitter bots with “MAGA,” “deplorable,” and “trump” in the handle and avatar images of young women in bikinis or halter tops, all posting the same headlines from sources like the Kremlin broadcaster RT. But Twitter can’t stop the flood of bots on its platform, and the botmakers are getting smarter at escaping detection.

What’s going on? That’s what Sam Woolley is trying to find out. Woolley, who joined Institute for the Future as a Research Director, was the Director of Research at the Computational Propaganda Project at Oxford University. We asked Sam to share highlights of his research showing how political botnets—what he calls computational propaganda—are being used to influence public opinion.

What is a bot?

When I speak about bots in the context of the Computational Propaganda Project, or my other work on disinformation, what I’m usually speaking about is social bots, which are a special type of automated software program that runs a profile on social media or that automates a profile on social media. We coined the term “political bots” and we’re interested in social bots that do political things online.

How does a bot actually work? How does it write coherent sentences, and craft messages intended to promote a specific agenda?

There are different ways a social bot can be constructed. One of the things you can do is build a bot that accesses repositories of information, so the bot can be linked to a series of phrases that the programmer has pre-written. The bot can say, “What do you think about this?” And then link to an article. Maybe the article’s from Breitbart, or from MSNBC, with the goal of sharing particular news. That’s a fairly rudimentary way of programming a bot. The other thing you can do is build bots that aren’t meant to communicate on the front-end with people at all. Rather, they’re built to do what we call “passive interaction” with particular profiles. Those types of accounts do nothing but retweet content on Twitter. They’re built specifically to be sold to a bidder that then uses them to retweet their content.

How effective are bots at fulfilling their purpose?

There’s certainly a spectrum of effect. During the U.S. election, for instance, bots were able to infiltrate the highest levels of social media influence by interacting with accounts that we know to be human accounts, and that we know to be retweeted and liked and followed and interacted with by lots and lots of different people. Those accounts often interacted with bot content, retweeting bot-related content. The bots were active members of that person’s social sphere and network. We know that bots can absolutely have an effect on the communication processes that happen during an election. They can be used to inject information into the dialogue.

Another way that bots can be used is to take up a particular conversation topic or to support a particular person, candidate, or idea, in order to create something I call “manufactured consensus.” Basically, the bot, or botnet—which is a collection of social bots in this case—is massively



boosting a topic. The botnets leverage their computational advantage to post thousands of times faster than a human could, boosting a hashtag or a topic or a person to make them look much more popular than they are. And oftentimes, what we're seeing is that Facebook's news feed will pick up that topic because it thinks it's real traffic and shows it to regular people.

There's an arms race between bots and people who want to stop them.

Yeah, there is. It's absolutely an arms race, and to be frank with you, oftentimes the people who are building these accounts are a step or two ahead of the people attempting to detect them, including the social media companies, but also researchers like myself and my team. It can be fairly frustrating. The more common ways of detecting bots, i.e., looking for really low follower numbers, but really high followed numbers, or looking for no Twitter picture, are increasingly becoming obsolete, because people now understand the most basic ways of detecting a bot.

Is it expensive to hire a bot army?

It ranges. You can buy an unsophisticated bot army on Fiverr for a really small amount of money. They will support you, but probably the accounts will be suspended quickly. There's still value in them. My former colleague, Gilad Lotan,

wrote about his experiment buying a really cheap Twitter following. Over time, the bot network fell off, but lots and lots of humans also followed him, so at the end of the day, even though most of the bots got deleted, he had a much larger following because of the illusion of popularity.

The more expensive networks, which you can purchase on the Dark Web or using other mechanisms, including hiring contractors that offer this as part of their kit, can range in the tens of thousands of dollars. Each bot persona will have its own Twitter profile, Facebook profile, a LinkedIn account, and various other accounts associated with it, and the bots will be updated and run by people.

How tied in are these bot developers with organized crime, particularly in Eastern Europe?

They are quite tied in with organized crime. One way we can begin to understand bot networks is to look at money laundering. In Eastern Europe, the people who are building these bots are supported through nefarious means. But there's also a lot of tie-ins to Southeast Asia, and South America. You can look at this guy, Andrés Sepúlveda, who told people that he had worked for all different governments to sway elections throughout South and Central America. He's gone on the books about how that works, including using Twitter bots that are absolutely tied in with the criminal underside.

Post Money

The basket of desires
and how sellers can tap it

by Chris Kalaboukis

People don't want products or services. They want their desires fulfilled. People will increasingly outsource this important job to software happiness agents devoted to discerning and fulfilling their every desire. Smart sellers will market directly to these agents as suppliers of happiness, which almost incidentally will come in the form of goods and services.

In this future, the Internet of Actions (IoA) will identify everything that makes an individual happy, using detected preferences, explicit and implicit communications, and social circle behavior. The data will be captured by sensors, data harvesting, and tracking, and run through algorithms that use collaborative filtering and deep learning to generate a private, happiness wish list, a secret accounting of everything that they want and aspire to attain, their “basket of desires.”

This basket contains physical objects that they may want, such as an antique—or antique-looking—distressed brown leather messenger bag. It also contains experiences they would like to have—maybe a trip to Thailand to visit Phraya Nakhon Cave. It could even contain emotions they'd like to experience, real or virtual—a woman contemplating motherhood, may wish to experience emotions such as the joy or fear of childbirth in VR before she decides to actually go through with it).

Once created, these IoA systems will fulfill those desires on behalf of the customer, at the most appropriate time and place. Agents will relieve the customer completely from the need to fret over pesky things like shopping to buy things, managing money (financial literacy is waning anyway—would many be that sad if this went away?), and having a job (we are already seeing massive shifts from having a career to a gig, and finally, to a task-based, algorithmically-delivered economy). Working for money will be replaced by completing tasks to acquire items in the basket. Money, as a concept, will no longer be visible, or even useful, to the individual.

Let's take a look under the hood. What happens when a happiness agent decides it is time to purchase an item in its owner's basket of desires, and deliver it to them at the right time and place? It starts by throwing a request (deliver this item to this place at this time for this price) out into a global virtual marketplace, where the happiness agent and a multitude of provider agents negotiate toward a mutually beneficial result. Except in the case of an extremely rare item, the transaction is completed in nanoseconds. Hundreds of thousands of provider agents will bid to fulfill the customer's desire. The customer won't see or think about the cost or transaction details.

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If you are a goods or services provider, how will your agent be able to get the sale, if the price is always the same, down to the nano-penny, from every other provider agent? If it knows the contents of the customer's basket of desires, then it could offer the customer agent a “sweetener,” something else that the customer may want, that can be thrown in, from your network of partners, to clinch the deal. Here's the scenario:

Sophia is a gig worker who completes tasks for hundreds of companies, people, and agents. They don't pay her in cash, but in a percentage of value toward a new object or experience in her basket. In her basket, among other things,



she has a new VR rig, a Versace dress, and a trip to Italy. When her washing machine is about to run out of detergent, her basket asks her agent to get some. The agent asks retailers and brands to provide the detergent and negotiate an exchange of value. In an instant, they all provide the best possible price for the detergent, each of which are nano-pennies apart. The customer agent then throws out requests for sweeteners to the deal, to see if any of the retail or brand agents can enhance any of the upcoming experiences in Sophia's basket to win the business. The provider agents search for a way to help Sophia realize a desire. One provider agent returns with an offer for a free fiber optic cable toward her new VR rig and another offers a free ice cream cone at Palazzo del Freddo Giovanni Fassi in Rome, for her trip. Sophia's agent opts for the ice cream cone, and the deal is made. Later, when Sophia has a free moment to browse through her upcoming trip to Italy she discover the ice cream cone voucher. She can trade that cone's value for something else, if she likes.

In this world, customer and seller agents quickly come to a static state on price, place, and

time. There will almost always be a seller agent who will come to a profitless price, and if other seller agents match that price, they will not make the deal. In those cases, the seller agents can ask the customer agent about something else in the customer's basket. It's the equivalent of a salesperson asking, "Can I get you anything else to make this sale happen right now?" The customer agent may then reveal that the customer is planning a trip or something else from the basket. The seller agents then mine their partnerships for something to offer to the customer agent to tip the deal in their direction. They may come up with a plethora of deal sweeteners, and in the end, the customer agent will select the one that it feels its customer will appreciate the most, based on the priority of the items in the customer's basket of desires.

In this future, sellers can no longer compete on price—they will need to maintain networks of collaborators who can provide that deal sweetener, at little to no cost to the seller, to make a sale for any kind of profit.

To win, sellers must look beyond price, service, and even product, and deliver happiness.

Digital Twins

What if we could get better answers from what-if questions?

by Mark Frauenfelder

“*What if* we reduce the enclosure thickness two millimeters so we can make room for a bigger battery?”

“*What if* we shut down the air conditioning on the factory floor when people aren’t present?”

“*What if* we tell our customers to perform oil-system flushes on leased equipment less frequently than we currently specify?”

“What if” is a common question in every organization, because it’s the first step in optimizing existing processes or developing new ones. There are four main ways to answer a what-if question: We can rely on our imaginations. We can use our experience and historical data. We can run tests and analyze the data. And we can develop models and simulations to see what happens.

Often, using one or more of these methods can provide useful answers. But we won’t learn if the decision we make is good until we try it in the real world. That’s because these methods—visualization, experience, tests, and models—are more or less disconnected from the real world.

Here’s a what if: *What if* you could connect real things to virtual counterparts? If you had sensors attached to things, you could send the sensor measurements to software models of those things. You could then tune the models so they respond just like their real-life counterparts do. They become “digital twins” that operate in sync with their physical siblings.

When physical things acquire digital twins, and they become entangled with sensor data, new possibilities emerge:

1. X-ray Vision

Things in the real world are subject to variations in heat and humidity, mechanical wear, and other environmental insults. Dashboards with sensors and gauges on machines give us a limited key-hole view, but digital twin technology gives us 360-degree X-ray vision to see what’s going on under the hood. The digital twin becomes alive when it’s fed real-world, real-time data. Service teams can look at a digital twin on a display and see all the components and their vital signs. If a bearing is chattering and hot, it will appear bright red on the twin, prompting the service team to replace the bearing before it leads to a costly catastrophic failure. Digital twins will be combined with predictive algorithms to automatically generate preventive maintenance schedules, which will help avoid equipment downtime and customer dissatisfaction.

2. Increased Productivity

When Maserati was designing its Ghibli sports car, it used digital twin technology to connect development engineers’ designs to manufacturing engineers’ assembly factory designs. In essence, Maserati created a virtual car and virtual factory, which could accept and respond to data produced by their physical prototypes. As a result, the time-to-production dropped from the typical 30 months to 16 months.

A Siemens factory that makes computer-control systems in 1,000 different varieties has a nearly 0 percent defect rate, in large part because the entire factory has an identical digital twin that Siemens uses to design and test components and assembly equipment before the physical factory takes over. Today, some factories are requiring vendors to provide digital twins along with the components they supply.

3. Improved Products

Smart connected products are giving manufacturers unprecedented insight into how their products are being used. Incorporating digital twin technology into these connected vehicles, machines, consumer electronics, robots, and other manufactured equipment will change the nature of the buyer-seller relationship. Think of a construction company that buys or leases



backhoes from a heavy equipment manufacturer. When the backhoes are outfitted with sensors that measure engine temperature, loads on moving parts, vibrations, component failures, noises, and so on, the data will be wirelessly transmitted as streams of data in real time to digital twin backhoes that respond in a realistic way to the data. The customer, as a data provider, and the manufacturer, who uses the data to make better backhoes, become partners who share a common goal—developing the best backhoe possible.

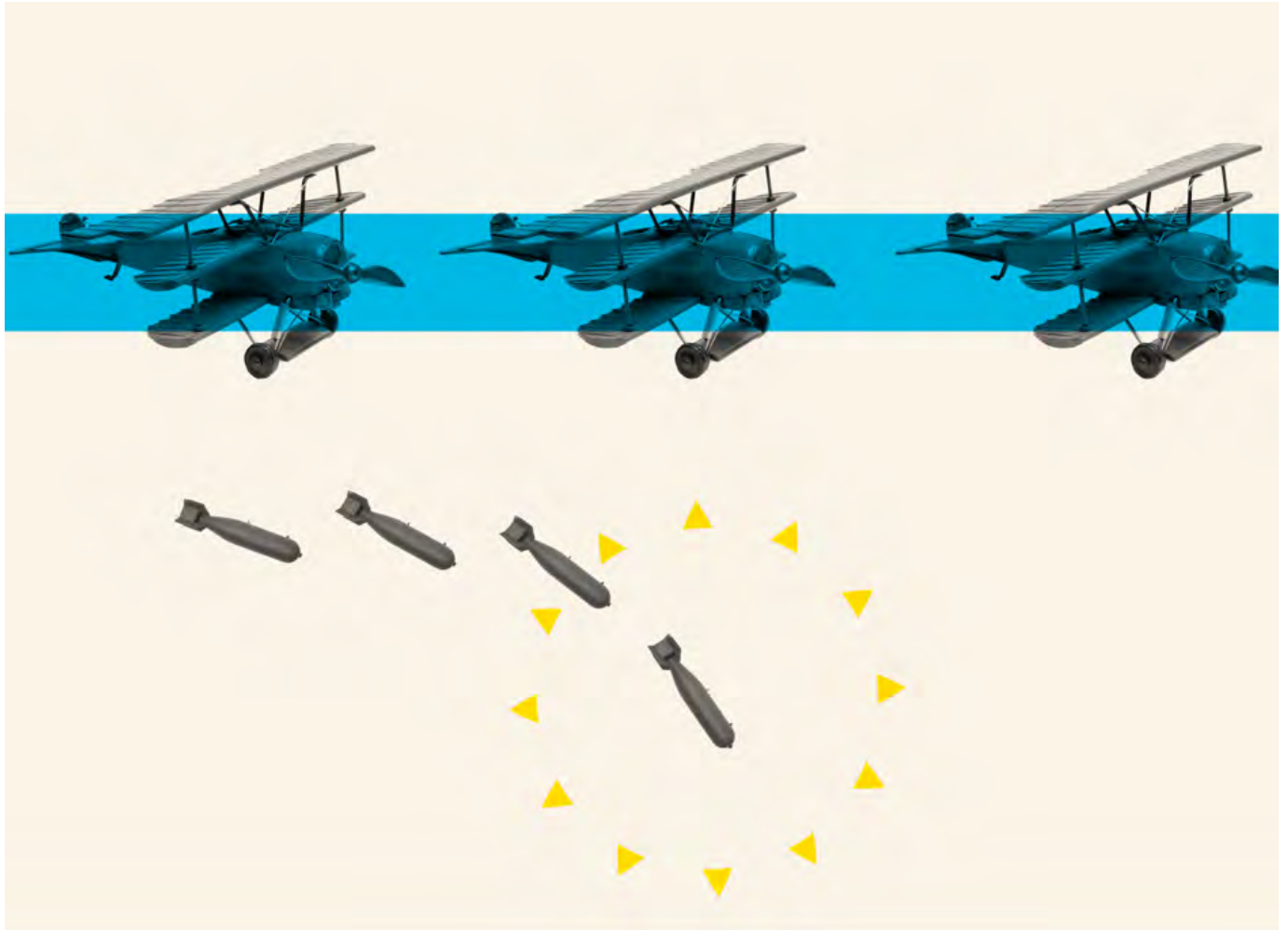
At the 2015 LiveWorx Technology Conference in Boston, the Internet of Things (IoT)/augmented reality platform provider PTC demonstrated a bicycle equipped with various sensors that fed data to a digital twin bike, which was shown to the audience on a screen. The digital bike moved and responded in sync with the physical bike that a rider was pedaling on stage. “The digital twin is a replication of the physical product,” Mike Campbell, PTC’s Executive Vice President of the CAD division, said at the event. “Today, as an engineer, when I design a product and send it out in the market, it sort of goes to the dark side of the moon. I don’t really know how it’s used. Unless something breaks and the customer gets angry, I don’t know what happens. A smart connected product gives me a chance to understand how the product is being used in the real world and to further optimize the product to make sure it is meeting the requirements and is successful in the environment where it is being used.”

4. Optimized Health

People (and other living things) can have digital twins, too. Like an advanced Fitbit, your digital twin will know when you sleep and exercise, what you eat, your hormone, cholesterol, and blood sugar levels, and more. Your digital twin’s virtual physiology will respond in a realistic way to these measurements. You will be able to press the fast-forward button to generate your extrapolated health profile and identify problems down the road (“Type 2 diabetes in 3.5 years”). Like a retirement income calculator, the system will prescribe a customized dietary and activity regimen to ensure optimal health.

The Future of the Digital Twin

In 10 years every connected thing will have a digital twin pulsing in the cloud. It will be connected to its physical twin, mirroring its behavior. The digital twin will be replicated and connected in new ways to other digital twins, to be used in meta-simulations to test new supply chains, factory floor plans, and business models. Digital twins will be connected to security-focused “digital ghosts” that replicate control systems and identify hackers’ attempts to spoof sensor readings and disrupt systems, as well as be able to safely run penetration tests. The digital twin will be the foundation of the ultimate what-if system, providing answers that come closer to being right than ever before.



Maria Konnikova and Kevin Kelly discuss how robot violence could make the world a better places

by Mark Frauenfelder

Kill Decision

South Korea has robot snipers at the North Korean border that can recognize and kill a person from a mile away. They can shoot them dead in their tracks. The sniper-bot factory makes the robot with the ability to kill what it sees. But at the request of the South Korean military, the manufacturer modified it so a human must enter a password to give the robot the go-ahead to shoot. From a technology perspective, a killer robot doesn't need a human in the loop anymore. What is the role of humans in the robot

battleground? We asked two of our favorite thinkers to discuss the issue. Kevin Kelly is the co-founder of *Wired* magazine, and the author of several books, including the *New York Times* and the *Wall Street Journal* bestseller, *The Inevitable*. Maria Konnikova is the author of two *New York Times* bestsellers, *The Confidence Game* and *Mastermind: How to Think Like Sherlock Holmes*. She is a contributing writer for *The New Yorker*, where she writes a regular column with a focus on psychology and culture.

Mark Frauenfelder: Do you think it would ever be a good idea to take humans completely out of the decision-making loop when it comes to autonomous combat robots?

Kevin Kelly: I actually do. It will help us get rid of some of our assumptions about conflict, and killing people is a way to do it. The process of delegating these jobs to robo-soldiers may, in the short term, be horrific, but in the long term, will make it clear how stupid, and basically immoral it is to kill, and it will be harder and harder for us to justify *anybody* doing it. This is one of the ways in which artificial intelligence (AI) and robots will make us better humans.

Maria Konnikova: I do think that's a very good point. My initial reaction was that no, taking humans out of the equation is not a great idea, because we've seen, over and over, that our ability to create sophisticated technology is outpaced by hackers' ability to hack into that sophisticated technology and take it over. And you have this happening all over the world. The second that we invent something, someone will figure out how to break into it. And so, if you remove the humans that are actually supposed to be in control, you still have the possibility of sabotage and a lot of different things going wrong, *and* you don't have anyone who can actually override it. Maybe I'm being alarmist, but I'm never comfortable completely delegating to technology, just because I've spent years looking at how people can take advantage of technology, and do take advantage of it.

If someone can program robo-soldiers to be ethical, someone can hack them and program them to be "ethical in a different way," that to *us* would be very unethical. What happens if that's the model that ends up winning? I realize that this does sound dystopian, but there are lots of examples in history, and part of it comes from the fact that I did grow up in the Soviet Union when it was still the Soviet Union. So I always have a mindset that things can get bad a lot faster than we realize.

Kelly: Yeah, so the only alternative to this, is to say, "No, no, no. We humans want to reserve the

right to kill each other." We're not very good at it, by the way, because we will miss. We're not very precise. We're very emotional. Machines aren't going to be accused of war crimes, as long as they're not programmed into ... they may be hacked into being that way, but in terms of legitimate things, they'll be very rational. They can be very precise. In fact, they may be able to hurt someone without killing them. So, they can probably, in the long term—again in their kind of legitimate, un-hacked version—be better at it. But we're saying, "No, no, no. We kind of want to do that ourselves."

Konnikova: I love your point that, eventually, it will be difficult to justify any kind of killing, but I'm genuinely curious about the interim, because we already have these debates about drone warfare, and how that, because it's not human, you've abdicated your responsibility—even though humans are piloting them—because of the factor of removal? Are you worried at all, that in the medium term rather than the long term, we're actually going to see more violence, because it will make it more removed?

Kelly: Right, like drone warfare, where the guys are in air-conditioned containers, in Arizona, and they're killing people in Africa, and it's not face-to-face.

Konnikova: Right, and if you have these robot soldiers, especially if they don't even have human control, then that makes that problem a lot worse.

Kelly: Superpowers, like the U.S., maybe China, Russia, will tend towards these things, because the casualty rates are low, but like a lot of things, there's a double standard, because you know, if these armies were coming *here* killing people, we'd be very unhappy about it.

So, yes, in the short term, whether we'll see more violence, I don't know. I buy Steven Pinker's argument, that in general, the technology and the globalization of the world has decreased violence overall, and that trend will continue, so I don't think that having robo-soldiers will suddenly change that overall trend.

If you have robot soldiers coming to kill you, people are not going to be happy. It causes a debate. It says, “Is this what you want? Why do we have machines killing?” And then you have to say, “Well, why do we have humans killing? Why is it better for a human to kill than for a robot to kill? How does that make it better?”

So, while there will be plenty of turmoil, and conflict, and short-term massacres, in the long term, this will actually continue to decrease violence in the world.

Konnikova: Even if it falls into the wrong hands? Like Putin or Trump having the technology, and getting mad, and deciding, “Let’s do this,” and now you don’t have human oversight.

Kelly: It could happen once or twice.

Konnikova: But is that not enough?

Kelly: Enough for what?

Konnikova: For mass destruction.

Kelly: Yeah, it’s like we had two atom bombs, and that seemed to be enough. Actually, I’m of the view that both of those were unnecessary, that we would have won the war anyway, but we didn’t continue doing it, because everyone realized that it was out of hand. So we could certainly have some kind of the first use of this being a massacre, but it also being a lesson, if it was done wrongly. But I don’t think that it necessarily has to be that way. We could train robo-soldiers to be ethical, and moral, and better than us, so that’s the difference. It’s like, you’re much more likely to have this disaster by kind of outlawing them.

Konnikova: I hope, I really hope, that forcing more people to consider these issues will get us to a good place. I’m not 100 percent optimistic, just because I’m not an optimistic person, but that’s probably clear.

Kelly: Well, you’re talking to one of the most optimistic people on the planet.





JORY17

How the Internet of Actions will transform everything to do with food

by Max Elder

Billions and Billions Transacted

In 1994 a journalist named Josh Quittner registered the domain name *mcdonalds.com*. On assignment for *Wired*, Quittner called McDonald's corporate headquarters to find out if they cared. He asked a McDonald's media relations representative if anyone there could talk to him about McDonald's Internet plans. She did some digging and told him later, "I don't have anything for you, and I probably won't have anything for you. I've left a lot of voicemail for people, but no one seems to know anything about it." So Quittner did what any reasonable

person in possession of the domain would do—he set up *ronald@mcdonalds.com* as his email address.

McDonald's eventually wised up and got the domain from Quittner. Today, server farms are as important to McDonald's as potato farms. The hamburger giant has greatly benefitted from Internet-based communications—every aspect of its operations is dependent on high-speed data processing, from commodity market analysis to social media marketing. And over the next decade, the physical components of McDonalds

—trucks, shipping containers, grills, employee uniforms—will become embedded with millions of intelligent sensors, processors, and effectors that communicate with each other and act on behalf of other machines, people, and organizations. McDonalds, along with every entity that adds value through coordination, will use Internet-connected objects and environments to produce well-orchestrated experiences powered by the Internet of Actions (IoA).

Why Food is Ripe for the Internet of Actions

The experience of food is an ever-changing sensorium of taste, smell, texture, and community. It's the experience of the farmer and soil scientist working together to cultivate a crop. It's the overworked volunteer team preparing 5,000 meals a day in a camp for climate refugees. It's the chef working with the biohacker to invent new proteins and the food retailer working with the virtual reality (VR) game designer to reimagine how to shop for groceries. All of the areas can be greatly enhanced with IoA technology.

For decades, meeting the needs of busy people scrambling to fit food into their lives has driven innovation for new food experiences. But we are facing even greater challenges today. The political stability of democracies is under threat. The climate is becoming increasingly volatile. Automation is on the rise, and conventional daily rhythms are being disrupted for many reasons. It's clear that 21st century food experiences will happen in very different contexts from the way we experience them today. We'll need to adapt to these changes by creating new eating and drinking occasions, new pathways and biozones for sourcing our food, and new strategies for ensuring safe, sovereign food in turbulent times.

Automation will be a major driver that rewrites the story and the context of convenient food access. Over the next decade, robots and algorithms will transform the way we access food on the go. Already, robots are cooking and assembling fast-food burgers, allowing for on-demand customization without sacrificing speed and efficiency. Automation is turning grocery stores into super-sized vending machines and food carts into self-delivering food services. As platform apps connect people to these services, technologies will get smarter, and experiences will become more streamlined and customized.

In the midst of any eating experience, the

story of the place: the utensils, the lighting, the music, and the overall ambiance will all be related and integrated in unprecedented ways. Current marketing and food experience design already leverage aspects of context like color and lighting that point in this direction. But in an IoA, where objects are animated and connected, new opportunities will arise to incorporate context into food experiences.

Signals of Change

We can begin to envision how every aspect of the food system will be transformed into seemingly magical experiences by looking at current IoA innovations in the food space.

Food with a nose

- C2Sense has developed an “artificial nose” sensor that detects ethylene, a gas naturally released as produce ripens. An increase in ethylene signals an acceleration of ripeness. (If you've ever been told to stick an avocado in a paper bag to help it ripen, that is a DIY attempt to trap ethylene.)
- Smart fruit labels with C2Sense will enable grocery stores to sell fruits and vegetables at their peak and allow customers to scan produce via a smartphone app to ensure they purchase food with their desired level of ripeness. In the next decade, sensors that monitor ripeness of food will be embedded into packaging, storage units, and grocery store shelves and will sense not just ripeness, but will monitor a plethora of factors, like micro and macro-nutrient levels, accurate caloric content, and microbial diversity.
- Your grocery shopping experience will become highly customized to your preferences. Your smart watch will get an alert that the strawberries you love are at the ripeness level you prefer and are available at the *bodega* around the corner. Just click the berry icon and they will be held for you, or delivered wherever you happen to be at the moment.
- Your smart cookbook's built-in nose will sniff the ripeness of your groceries and adjust the cooking time and methods to maximize flavor.

Pricetags that fluctuate by the second

- Ripeness sensors are just one way to provide real-time information about a food product. New real-time data collection and analysis tools will proliferate over the next decade,

We can begin to envision how every aspect of the food system will be transformed into seemingly magical experiences by looking at current IoA innovations in the food space.

which will lead to the electronic and dynamic pricing label. On shelves, boxes, or food products themselves, electronic labels enable stores to dynamically change prices and promotions across every shelf, in every store, everywhere. Prices may increase as fruit reaches peak ripeness, or decrease as bananas get soft or the clock ticks closer to closing time for the store. These electronic labels can contain information about total stock availability, reviews from social media platforms, and geo-located promotions targeted at specific shopping carts.

- Over the next 10 years, electronic labels will be connected to more and more smart objects in the store, radically transforming the context of walking down a grocery aisle. Cameras will see what you have in your shopping cart, and predictive algorithms will anticipate what you're looking to buy, adjusting prices for specific products accordingly. Financial information about your purchasing history will be leveraged to adjust pricing based on what you've been willing to spend in the past, or even on the price of the clothes or jewelry you're wearing.
- The implications extend beyond the walls of the grocery store. Dynamic pricing can help provide greater purchasing insight to the local baker who needs to understand when and how much to bake, or to the local farmer trying to maximize profits by only harvesting when the market is right.

Meal kits with a chef-in-the-box

- Sensor and pricing technologies will be part of every meal kit delivered to your doorstep.
- In 2017, Amazon filed a trademark patent for a meal-delivery service with the motto: "We do the prep. You be the chef." With a targeted acquisition of Whole Foods and their unparalleled logistics of delivery, it's clear that Amazon has plans to disrupt the meal-delivery space.

- In the constant quest to differentiate, meal delivery services will be enabled by the IoA to turn home cooking into a new context for learning. Meal kit boxes will be embedded with AI to not only deliver the food, but also deliver customized cooking advice (like adjusting recipes with an awareness that you don't buy anything containing sweeteners) and instructions while you're in your home.
- Paired with your smart kitchen, the delivery box will monitor your technique and provide real-time cooking feedback so that you will never burn your rice again. Different boxes will tap into the cult of personality behind different chefs, just like the emerging AI assistants today have different tones and intonations. After the meal, the chef-in-a-box will monitor your success and adjust future meals to ensure you're constantly challenged to master new cooking techniques.

Farm as data centers

- The Leafy Green Machine is a vertical, hydroponic freight farming system built inside a shipping container that is capable of growing your typical hearty greens, lettuces, and herbs. The Leafy Green Machine already is filled from floor to ceiling with sensors and AI to ensure maximum yield. The IoA will enable freight farms to communicate with each other, creating a distributed network of agricultural data centers that can learn from one another, diversify the types of crops grown to fulfill the changing demand of their consumer base, and tighten the food supply chain.

Neighborhood Food

- Falling Fruit is a global urban harvest map that unites foragers, freegans, and urban eaters by collecting data about over a half million free food sources, including trees, plants, fungi, and even dumpsters containing available food for public harvest.
- In an Internet of Actions, trees and dumpsters will transmit information about fallen fruit or discarded food to adjacent smartphones, local chefs, or even your smart kitchen (that knows you need a lemon for dinner tonight). The context around food procurement resources and culture will be crowdsourced and the ingredient supply chain will be hyper-localized.



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