

LIBY HAYS PRESENTS

Reece Francis Perkins

Amitabh Shrivastava

Antoine Catala

Randy Sarafan

Ray Wang

Nicolas Kubail Kalousdian

Jacques Vidal

Brian Oakes

Cody Frost

Jack Reece

Shay Salehi

Ian Cox

Tee Topor

Petoi

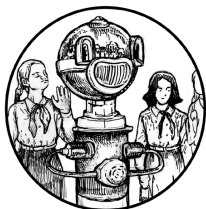
Owen Trueblood & Karyn Nakamura

with music by Fynn Kugel  
& Rebecca Schrader

& robot guests

4-7PM (COME IN, COME OUT)

SUNDAY OCTOBER 19. EARTH, 49 ORCHARD STREET, NYC. EARTH.NET



# EARTH Robotics Expo

OCTOBER 19, 2025  
49 ORCHARD STREET, NEW YORK

In 2025, we are at a pivotal moment in robotic history.

The cybernetic dream for machines to emulate the intelligence and dynamism of living beings is now our accepted reality. Alongside the much-publicized machine learning boom, robotics is advancing rapidly (with recent progress in bipedal movement, for example). It is the next outpost on the science-fiction-to-reality pipeline, a reified outgrowth of the popular imaginary. It seems likely that in the coming decades, robotics will be integrated more intimately into our lives in both labor-saving and affective applications. Additionally, Moore's Law and the standardization of chip manufacturing have made robotic engineering more accessible than ever.

We hope to capture the excitement and potentiality of this moment with an unprecedented style of event: both **robotics expo** and **robotic performance piece**.

We are recruiting a **wide array of robots** from artists and technologists in the New York area to **fill the gallery space** in a **playful, free-wheeling group performance**.

The 3-hour performance will be set to a cinematic score of **live violin**. The goal is to create a memorable **aesthetic experience**, synthesizing sound and visuals, as well as the haptic qualities borne of mechanical vibration. This exposition will be uniquely **transdisciplinary** in its scope: inviting artists, inventors, puppeteers, creature mechanics, entrepreneurs, students, hobbyists and Halloween prop makers alike to show their work side-by-side.

*A wheeled bot darts playfully between our legs. A table eludes us. A flesh-orb breathes in and out with yogic composure. A hydraulic platform reorients its pitch and yaw...*

Think the divine chaos of Tinguely's *Homage to New York* but in a more collaborative and less destructive mode. **We will create a transient robotics scene that exists for one night only.**

Monster maker David Kindlon has spoken of the "multiple parallel histories" of robotics including the fields of academic robotics, industrial robotics, Disney audio-animatronics, and Hollywood creature mechanics, which have only recently begun to "cross-pollinate." Independent makers are in the unique position to cross these threads themselves. This expo as a whole will embody this **transdisciplinary** spirit, incorporating both practical and fantastical, polished and provisional applications of new technology into an **emergent spectacle**.

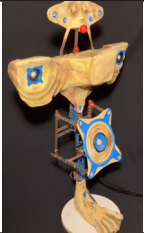
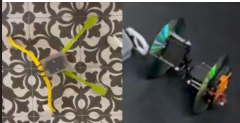
The performance will take place **Sunday, October 19 at 49 Orchard Street, New York City**. [EARTH](#) is a space for alternative cultural events directed by artist Christopher Kulendran Thomas, curator Annika Kuhlmann, and writer Dean Kissick. Past events have included experimental readings, music shows, plays and performances.

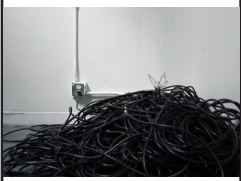
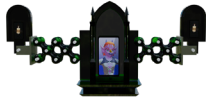
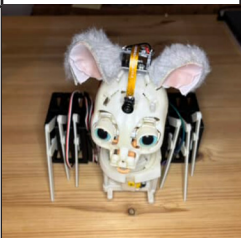
We hope to introduce EARTH's art-adjacent audience to technological possibilities and lay the groundwork for **lively and collaborative robotic performance works to come**.

-Liby Hays

## ROBOTIC ROSTER

| Artist                    | Title                        | Description                                                                                                                                                                                        | Image                                                                               |
|---------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Antoine Catala            | Robot Feelings               | Droids made in collaboration with art students in Sweden and roboticist in Paris. They were robots feelings, they were carrying emotions with them.                                                |    |
| Ian Cox                   | Automated Tarot Machine      | ATM is an Arduino based split flap display which aims to give users a satisfying tarot card reading experience.                                                                                    |    |
| Cody Frost                | Kinetic Randomness Generator | Little electromechanical random pattern generator!                                                                                                                                                 |    |
| Cody Frost/Ray Wang       | Drone Show                   | This is a live exhibition of drone as looking glass.                                                                                                                                               |   |
| Nicolas Kubail Kalousdian | Sun                          | An autonomous robotic sphere sheathed in interlocking, hand-carved wooden fragments. The largest panels are engraved with a Mesopotamian eclipse ritual, anchoring the piece in ancient cosmology. |  |
| Petoi                     | Bittle X                     | Open source, DIY programmable robot droid by Petoi.                                                                                                                                                |  |

| Artist                | Title               | Description                                                                                                                                                                   | Image                                                                               |
|-----------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Brian Oakes           | Encryption Device 1 | Aluminum extrusion, acrylic, fans, lava lamps, 3d printed parts in PLA, custom hardware, custom cables, custom PCB's, Lava lamps, motors, light bulbs, power supplies, belts. |    |
| Reece Frances Perkins | Untitled            | Pla, acrylic paint, MyCobot.                                                                                                                                                  |    |
| Reece Frances Perkins | Lament              | Metal pla, servo motors, plaster, upholstery buttons, resin For Elana and Ada.                                                                                                |    |
| Jack Reece            | pppp                | A multi band vibrating figure made of rubber and erector set.                                                                                                                 |   |
| Randy Sarafan         | NY-Style Bots       | Glutenous city diet staples on the move.                                                                                                                                      |  |
| Randy Sarafan         | Misc. Simple bots   | Simple Bots are a series of mechanical creatures made out of commonly available materials.                                                                                    |  |

| Artist                          | Title                                      | Description                                                                                                                                                                                                       | Image                                                                              |
|---------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Shay Salehi                     | Sensitive Dependence on Initial Conditions | A kinetic stainless steel sculpture of a butterfly. The work explores the tension between nature and technology, fragility and control, and the ways power—both literal and metaphorical—circulates between them. |   |
| Tee Topor                       | on god (simple green)                      | A mechanical relic that is home to a digital avatar who questions their devotion to their creator.                                                                                                                |   |
| Owen Trueblood / Karyn Nakamura | "Cat head"                                 | Now featuring lasers (!!!)                                                                                                                                                                                        |   |
| Jacques Vidal                   | Fish                                       | Type A Billy Bass... a time-conscious fish that checks the watch attached to its tail                                                                                                                             |  |

## IN THIS ZINE

**INTERVIEW WITH IAN INGRAM** conducted by Alex Freundlich and Liby Hays

**LOCHOS**  
by Char O'Dair-Gadler

**DISOBEDIENT ELECTRONICS**  
**MIDTERM PROPOSAL**  
by Cody Frost & Ray Wang

**LIVING OBJECTS**  
**HISTORY** by Liby Hays

**SOPHIA THE ROBOT**  
**FASHION REVIEW**  
by Isabelle Rea

**USING ROOMBA AS A**  
**MOUSE** by Tod E. Kurt

# INTERVIEW WITH IAN INGRAM, PT.1

by Alex Freundlich and Liby Hays

Ian Ingram is a San Diego-based artist whose work pioneers novel forms of robot-animal interaction. While Ian couldn't participate in our Provisional Robo Theater, he kindly took the time to answer a few questions from my friend Alex Freundlich and I. Part 2 potentially to come!

*1. In the cybernetic school of thought, machines and living beings are framed as parallel forms of complex, feedback-driven system. How do robots relate to the category of life for you?*

A long-standing question, even amongst roboticists, is what exactly *is* a robot. I remember in the 90's and early 2000s as I engaged more with that question, learning of a common definition that stated that a robot was something that did three things: a robot, firstly, sensed the world, secondly, acted upon the world, and, thirdly, determined what actions to take based upon processing what was sensed (that processing was sometimes liberally called "thinking." Calling it that was definitely more liberal than now.) Folks would state that definition and when given the example of the thermostat, which does those three things, say "well, then I guess a thermostat is a robot and we just didn't know it." But, frankly, we all *do* know that a thermostat isn't a robot. Something was missing in the definition.

In 2005, I put pen to paper to capture my theory of what was missing. In a nutshell, beyond the implication that a robot is artificial (wombats do all of the three things in the definition above but they are not considered robots...there does remain the follow-on question of whether, if wombats started to make wombat automatons, those would be robots or whether to be a robot humans had to have made you), I feel there is a fourth thing: that a robot has to create a semblance of agency, of mindful intent i.e. it has to set off all the circuitry in our wetware designed to detect animals, those other beings in the world we pay so much careful attention to because they could be predators that want to eat us, prey we want to eat, conspecifics we might want to form families, tribes, and societies with, etc.

So, hopefully finally wrapping around to your question :-), I think robots are in their very essence intimately linked to life and aliveness. They are—both in their depictions in fiction and their increasing manifestations in reality—tied to our own instinctual aliveness detectors and in parallel our struggle to define what being alive is.

Of course, the semblance of agency is definitely affected by who is making the judgment and what they know about the possible agent. Random behavior is often perceived as agency. And very simple behaviour can be, too. (At the risk of being a bit wishy-washy, I think a thermostat can even creep into the space of being a robot; particularly a thermostat these days). It is both true that we often attribute more mindfulness to an agent than is there and miss that there is more mindfulness in an agent because we can't perceive it. In 1998, I had made Wet Waggle, a performance by an underwater robot that did the waggle dance which honey bees use to tell other honey bees where they have found important resources. For a long time, humans didn't know the bees did this, even as we did sense agency in their activities, their signal was invisible to us.

The robot in *Wet Waggle* in a tank of water in a research lab surrounded by researchers whose focus was on other things was similarly sending a signal about where I had hidden little gifts around the city that was imperceptible to most observers. So, different people had different depths of understanding of the agency of that robot. Most likely presumed it was doing some research-related activity, perhaps calibrating itself. One person knew it was trying to send a message.



*Wet Waggle* (1998).  
Image courtesy of the artist.

## ***2. What are your current creative constraints, and how do you decide on them?***

My primary constraint is Rule #14: Work with local and abundant animals. When I brought *The Woodiest* to a residency in Germany in 2010 to do the performance *Nobody Told the Woodpeckers*, I spent the whole time I was there trying to find a black woodpecker and did not succeed. I decided that after all the effort to build the sculpturo-mechanical, power, control, behavioural, electrical, and other systems of a robot, I really wanted it to have its chance to interact with the animal it was designed to yearn to commune with. So for at least a few decades, I plan to only work with local and abundant animals. The next series of robots I made were for the lizards in my yard.



*Nobody Told the Woodpeckers* (2010). Image courtesy of the artist.

## ***3. Is robotics in any way a limiting factor in your imagination? Would you prefer to give them cells, organs, organ systems? Reproductive organs? Why or why not?***

I primarily view myself as a behavioural sculptor, someone who makes objects that have behaviour and where that behaviour is a core medium of the work. In many ways that I do this with robotics is an artifact of the materials of robotics (actuators, sensors, computers, control systems, machine learning) being the most straight-forward way to realize such objects at this time. I would guess that will remain true for at least a little bit longer.

I am also interested in behaviour, form, and Umwelt that is possible outside the constraints of what has to grow and had to evolve. I am clearly interested in the things that are the outcome of those natural growth and evolution processes. But beyond the sheer difficulty of working with cells, organs, and organ systems, they and the things that can be made with them are bound into a particular space of possibility, one that is marvelously already

explored by Nature. I do, however, borrow little pieces of organic systems here and there. For instance, in *On Beyond Duckling* in 2004, the robot uses eggshells for its pontoons and feathers for its oar blades.

**4. How much do your ideas evolve/change in the face of technological limitations? Do emerging technologies awaken previously dormant projects?**

My projects are absolutely constrained by what is technologically possible. But in many ways that is core to the work. A facet of that work is the exploration of the boundary of the real and imagined. Robots sit at that boundary and have done for thousands of years. So do non-human animals. When I build a robot that is placed in an ecosystem, intended to commune with an animal using that animal's signals, what happens—and whether anything like what I imagined happens at all—is dependent on the true nature of reality, including things like what the robot is really capable of and what the animal is really like. Our society is currently overwhelmed by fiction and we ourselves have had our epistemological muscles weakened, perhaps deliberately, so we can't always even detect it. Humans are always ready to make things up and get others to believe them and they make a lot of things up about animals, often things that make the non-human animals seem more like us, and they make a lot of things up about the possibilities of our technology. I am interested in what is true about both categories.

I wouldn't say that emerging technologies exactly awaken dormant projects as it never feels as if a project is truly asleep! But it is true that a new technology can expand a project. For instance, when I first built *Danger, Squirrel Nutkin!* in 2009, it was before the deep learning revolution and the object detection algorithms I was using were great at recognizing humans and quite so so at recognizing other squirrel predators. In 2012, everything changed and I retrofitted the robot with a convolutional neural network that not only was excellent at detecting dogs, it could tell you exactly which breed it was looking at. The squirrels are probably not discerning when it comes to breeds of dog (the smart squirrel move is almost always to treat the dog as a threat whether it be a chihuahua or mastiff) but the "mind" of my robot, at least its perception system, was suddenly much much more capable in its task, much more present in the world in way.

That pattern has repeated itself, particularly again because of the continued ground breaking in the last thirteen years of AI/ML, bodies I built with simpler minds have had those minds expanded to awaken more depth in their Umwelt.



*On Beyond Duckling* (2004).  
Image courtesy of the artist.



*Danger, Squirrel Nutkin!* (2009).  
Image courtesy of the artist.

## interlude: living objects history pt. 1

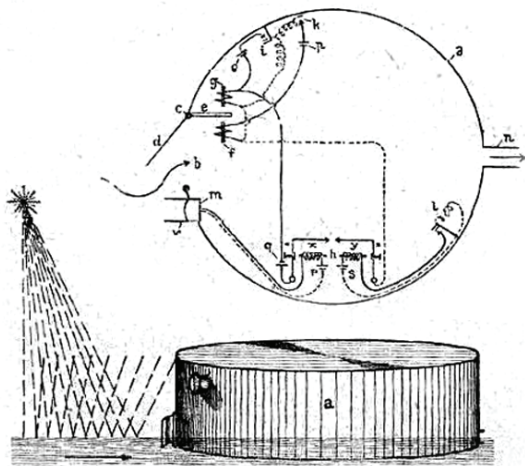
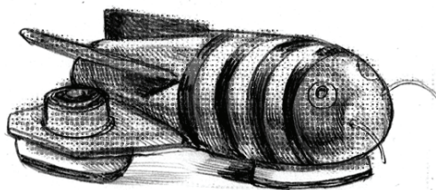


Abbildung 21.

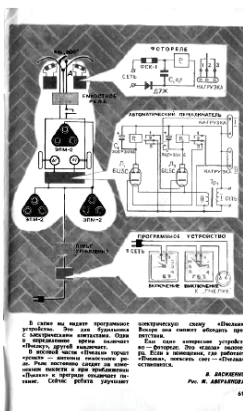
### 1920- Fritz Lux's Electro-mechanical "protozoon"

Submechanophobes beware! This model unicellular animal was designed to be anchored in a brook, half-submerged. As a metabolic conceit, water was considered "food" in the midst of the 'zoon's digestive process. Its water levels were kept in homeostatic equilibrium by mechanisms restricting or widening the entrance to its inner cavity. Over time the device could even "learn" via a reflex process.\*

### 1968- Russian Cybernetic Bee



\*A large wave would cause the protozoon to close its "mouth" to keep water out, via a contactor actuated by a magnet. While the magnetization was preserved, if the 'zoon perceived another wave (i.e., its photoelectric cell picked up on the glittering of water) it would close its mouth in anticipation.



info courtesy of  
Cyberneticzoo.com

## interlude: living objects history pt. 2



### 1963-1963- Pavlovian Dog teaching-machine

Frederick Chesson developed this device at the height of the 60's "teaching-machine" craze. It was meant to simulate the Classical Pavlovian Responses of conditioning (learning), extinction (forgetting), spontaneous recovery, higher order conditioning, learning curves, and stimuli hierarchy.

It was modeled after the canonical Pavlovian conditioning scenario: a dog who is fed whenever a dinner bell rings comes to salivate at the sound of the bell alone. To indicate hunger, the dog's transistor-powered tail would wag when a magnetic bone was held in proximity to its nose. The dog had the power to hear and see via a microphone and a photocell, respectively. The audio stimulus would activate a trigger-delay and if the food stimulus was presented during this interval, this coincidence (a reinforcement of a sound-food connection) would be recorded by the Conditioning Event Counter. Once a preset number of coincidences had been registered the dog would automatically wag its tail (signaling food anticipation) anytime it heard a noise.

HOWEVER if the sound-stimulus was presented without food another preset number of times (an anticoincidence) the dog would be reset to an unconditioned state and require retraining.

Chesson's machine also featured a simulation of "spontaneous recovery," a Pavlovian phenomenon in which a conditioned state is randomly recovered after a period of forgetful latency. It also simulated learning curves, or increased ease of learning and lower likelihood of forgetting the more times the conditioning-extinction cycle was repeated. (Fewer coincidences would be required to condition the dog, and more anticoincidences would be required to untrain it.)

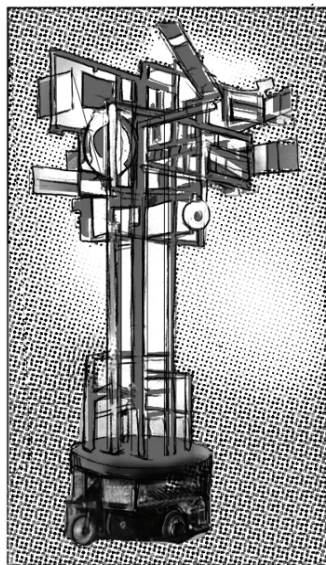
With enough training the dog could achieve "higher-order conditioning", and come to associate a third stimuli, like light, with food, due to the association between food and sound, and sound and light.

## interlude:living objects history pt. 3

### 1956- CYSP-1 , the first cybernetic sculpture

This 8-foot-tall work was an attempt by artist Nicolas Schöffer to create a "homeostatic electronic brain," which maintained internal equilibrium in response to its physical surroundings.

Its apparatus integrated three different elements: an "indifferent cell" guided by chance, "sensorial reactions" integrating sound, light and heat data, and an "internal determinism," in which these chains acted upon one another to (potentially) greater degrees of complexity. For example, when its photoelectric cell detected the color blue, CYSP-1 would speed up, while warm colors would calm it down. It was excited by silence and calmed by noise, excited by darkness and calmed by light etc. Its 16 polychromed plates would swivel balletically in response to various stimuli.



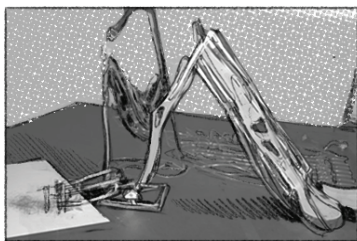
### 1952- "Theseus" the Maze-Solving Mouse

A maze-solver by Claude Shannon in which a magnetized mouse was led around a metal maze. After multiple attempts the mouse would determine the most efficient path through the maze.



### 2001-4- MEART Rat Neuron Drawing Machine

SymbioticA Research Group engineered this drawing machine by hooking up a mechanical arm to cell culture of rat neurons (an early-aughts example of "wetware"). Did the machine give insight into the existential condition of ratness, sublimating the apocryphal "rat's ass suspended from the ceiling of the sky?" (Stay posted!)



info courtesy of [Cyberneticzoo.com](http://Cyberneticzoo.com)

# LOCHOS

by Char O'Dair-Gadler

Pierre had developed C-PTSD from a series of stage pyrotechnics accidents. Otis tore his rotator cuff playing AirSoft on one of their few days off. Peng's SSRI made him gain fifteen pounds. Gyeol was still in school, and the "international" aspect of their group made the industry-standard skirting of child labor laws trickier. Yariel's company-mandated rhinoplasty had been botched, and the subsequent surgical revisions put him out of commission for official activities for nearly three months, though he had made a brief appearance on a pre-recorded fan call—wearing a mask, of course. Isak was just sort of old. Twenty-five, though according to all official fan resources, he was twenty-three. It's not like that was unheard of for an idol, but they'd only debuted a year ago, and Isak had been made acutely aware of the fact that he was the most senior member by four years. Gyeol was barely sixteen, after all.

The point was, the company had told them, they were fallible. Unu was not.

They hadn't said it like that when telling the members about Unu. They couched it like this: WYC Entertainment is a progressive international company revolutionizing the K-pop training and development model with LOCHOS, the first global boy group. They were committed to ethical production standards, and the members' mental well-being and physical health were the company's top priorities. Debuting Unu as a seventh member would mean that the human members of the group could be just that: human, and take the time they needed to rest and recuperate while LOCHOS still fulfilled the schedule demands expected of a group engineered to lead the next era of global pop dominance. Besides, being the first musical group to include an android as a member would ensure they remained firmly on the cutting edge.

The six of them had been carved from a group of one hundred and eleven trainees, ages twelve to twenty-two, from all over the globe—a process that had been documented in painful detail on the WYCTV survival program Mission!: StarSchool for Boys. They'd been selected by, supposedly, a combination of public vote and a rubric of mercurial criteria determined by a panel of judges and a shadowy cadre of WYC execs. They were all hard workers, that was for sure, and they all had a good broad-shoulder-to-slim-ribcage ratio. Unu wasn't a replacement, they assured them, but a reinforcement. Unu would carry the weight when someone needed to step back—record a line, film a segment, appear on stage. An understudy. A buffer.

Isak hadn't paid it much mind, at first, not really. Obviously, he thought it was stupid. Other groups had run these kinds of gimmicks before: debuting a set of virtual reality avatars that corresponded with real idols, releasing non-fungible tokens as merchandise. There were groups made up entirely of VTubers. A J-Pop outfit had tried and failed to launch its own cryptocurrency. This was just another in a series of trends that would look embarrassing in six months, a year. Isak had just believed he was managed by a company that was above such things.

Isak had expected Unu to be gummy and twitchy, like the androids he had seen on the internet that looked like a bunch of gears turning beneath a rubber Halloween mask, spelunking deeper into the uncanny valley by trying to approximate the look and feel of human skin and muscle.

It didn't have skin, first of all. It was more like a shell, a series of shifting plates that fit together over its wiry innards. Touching it felt like touching a tablet. Unu was a collaborative effort between WYC Entertainment and WYVern, the engineering and robotics subsidiary of their parent company. They had been wise in making it humanoid while not trying to make it human-like. Yes, it was pretty in an otherworldly way, but so was the rest of the band, with their many surgical tweaks, army of makeup artists and hairstylists, their heavily monitored diet and exercise regimen. Unlike them, it couldn't pass for human, nor was it trying to. It was just slightly super-deformed, like a fashion doll based on a male model, or a figurine of a video game character. The wig technology on its scalp plate was, even Isak had to admit, a marvel.

There was a roundness to Unu, a curved, underlit glassiness that made it similar to other friendly robots that already populated the world—smiley food delivery bots and chirpy singing robot waiters that served up stroopwafels and dumplings. So, that's what Unu was meant to be, Isak figured: a mascot. A cute concept character who would join them for one, maybe two cycles of comebacks. He didn't flinch when they scrapped material for their then-upcoming third mini-album to record a new single and video—uncreatively titled "Automatic"—to mark Unu's arrival. Its artificial tenor sang the chorus in harmony with the rest of their digitally altered voices. Its dancing was hypnotically precise and graceful, and gave Isak the feeling of watching an industrial hydraulic arm twist and weave, picking up boxes and placing them on a conveyor belt. The choreographer only had to demo the dance once, and Unu could mimic her perfectly. She would have the rest of the members dance, stop, and then ask Unu to replicate how a step should be performed—tighter, looser, slower, this time with vigor.

The problem came when they started having to re-record the rest of the songs on the mini-album with Unu's vocals. Coveted lines of lyrics, precious seconds, were now allocated seven ways instead of six—and they were never doled out evenly. Isak was lead vocal, and

now somehow Unu was singing the second chorus of the title track? The dance break was now split between Yariel and Unu, the robot? When the mini-album dropped, things got worse. Unu had its own fanchant. LORE—that was the name of LOCHOS' fandom—were going into debt buying albums in bulk, trying to get their hands on the hyper-rare Unu finger heart photocard. "Ugh, not another 'beret Isak!'" a fan groaned in an unboxing video. Isak fumed.

Isak didn't understand how they were supposed to act like this was normal. Why, for example, did Unu have to be stored in the small utility hallway in their company dorm when they didn't have a schedule, charging idly next to the washer-dryer? Isak grimly recalled a gag from a recent variety show appearance, where Unu had opened its chest cavity and used some piece of machinery inside as a heating element to prepare a cup of instant noodles, much to the canned delight of the hosts, two balding middle-aged comedians. How did they know this thing wasn't going to, like, blow up?

The rest of the members didn't share Isak's dislike for Unu. In fact, they seemed to welcome its presence. Once, Isak had returned home from physical therapy to find Pierre and Otis recording a cooking vlog with Unu, astonished at how it could crack an egg with one hand. Another time, he awoke to find Unu sitting with Gyeol at the kitchen table, helping him with Physics homework. Only Yariel seemed to share Isak's concerns regarding Unu, though his unease seemed to be based more in his own preexisting fear of demonic possession than anything.

In one of their rare moments alone, when the stylists were preparing Unu for solo shots during a photoshoot, Isak tried to bring it up with the guys.

"I'm telling you, in six months, they're gonna debut a new group, all robot," Isak had told them, shielding his face with his hand. "Plus, you know it's fucking recording us."

"Do you know how old you sound right now?" Peng asked him slyly. Fucking fatass.

"Seriously, man, I mean, it's Unu. He's not like I, Robot or some shit..." Otis laughed.

Yariel didn't look up from his phone, but Isak swore he could hear him praying under his breath.

Gyeol and Pierre were not paying attention at all and were instead engaged in a throwing contest, trying to see who could get a half-empty bottle of protein shake to stand upright.

Even if they had all hated Unu, it wouldn't have mattered. They had no say in the makeup of the group, the songs they sang, the clothes they wore, what they ate.

---

It obviously wasn't as smart as they were trying to pass it off to the public. It was easy to trick whatever kind of AI they had in there—in the many, many times Unu had tried to strike up conversation with Isak unprompted, it was simple to act paradoxical, to talk in nonsense riddles, to get it all tangled up in its own loops. But how smart was it? As smart as a toddler? A dog? A parrot? They'd been in Singapore, the final stop on the last leg of their mini-album promotion, when Unu started to crack. It was the encore, a stage of their title track "Limelight," the ending chorus. They were all exhausted. Isak was in the back right of the formation, directly behind Unu, with Pierre and Gyeol on his right. The part in the dance where they all lift their arms above their head in unison, cross them at the wrist, and then bring them down across their body with force three times while singing "You know I'm gonna hit that Limelight, yeah."

Unu had gotten stuck, jerking its arms up and down over and over again, suspended in place, unmoving when Otis bumped into it as the formation shifted over. Pierre, now ever alert to any onstage mishaps after the several pyrotechnics fiascos, cut in front of Isak and speedily pulled Unu offstage. Isak spotted the dimly glowing ochre of Unu's glass irises as it disappeared into the wings with Pierre—its eyes were snapping back and forth with extreme quickness, as if tracking a moving object and doubling back to catch a new one. Isak remembered seeing his mother's eyes do the same when they rode the commuter rail in Stockholm together when he was a child, snapping unnaturally back and forth as she watched other moving trains out the window. Seconds later, LOCHOS hit their ending pose, closing ranks to fill the visual hole left by Pierre and Unu.

By the time they all got off stage, someone had powered Unu off. It remained in idle mode—slumped over, chin to chest, legs outstretched in front of it—the plane ride home, and stayed like that days later in the dorm, in its regular spot in the utility hall. The technician arrived to service Unu late, after Isak and the rest of the members had returned home from dance practice. Isak was in the kitchen finishing his dinner—plain chicken breast and half a sweet potato—when they rang the video doorbell, flashing a WYVern ID card to the camera.

Isak hoped they'd come in and wheel him away to some facility or lab, never to be seen again. At least take the malfunctioning robot out of their dorm for a few days, please. But instead, the WYVern tech, pulling a large pelican case behind her, just gave Isak a cursory wave and set up shop, kneeling next to Unu right there in front of the washer-dryer.

Isak sighed loudly, several times, but this elicited no response from the technician. He resorted to peering into his bowl, playing with his unappetizing food, ripping the chicken up into white shreds, mashing the sweet potato down and dragging his fork

through it, tilling it into orange rows.

When he glanced upward at the technician, he saw that, in addition to opening Unu's chest cavity, she had unhinged its face plate as well. She was typing into some kind of monitor plugged into the port on its back panel—running diagnostics, Isak thought, though he truly had no idea.

He had never seen Unu like that. The chest cavity open, sure, that was basically a party trick at this point. Isak was surprised it hadn't somehow been incorporated into choreography. But the open face plate was something else. The technician parted Unu's translucent inner face plate—which pieced together vertically and held its teeth. The only remnant of Unu's face that remained were its closed eyelids. The technician then began twisting and pulling pieces and parts out from Unu's head and chest. Out came motors, and rotors, and fans. Tubes and hinges and screws, joints and wires and lights. Isak felt his face getting hot. Each component pulled loose revealed five more behind it.

How much could be in there? Isak thought of a definitely misremembered fact from a faraway science lesson—that the human intestines, when unfurled, would wrap around the circumference of the Earth. That couldn't possibly be true, but maybe whatever parts could make a robot dance and sing and laugh like a person could. The technician gingerly placed the pieces down into her open pelican case, hit the endoskeleton with a screwdriver, some compressed air, tapped away on her monitor some more, and then continued disassembling Unu's insides.

Isak felt his chest prickle. He felt himself wanting to ask the technician if he could have a go, if he could reach his hand inside Unu's cavernous head and see what came out. If he could climb inside the hole in its chest. She pressed on her monitor once more, and Unu's eyes came alive, glowing bronze under its closed eyelids, twitching to and fro again in that holding pattern, following imaginary trains. All of a sudden, the technician looked over her shoulder at Isak, and he realized that he had risen from his seat at the table and was now standing directly behind her and Unu. He raised his sleeve to his mouth and found that it was open, drooling.

Isak rushed back into his room, scaling the ladder to the top bunk. He pulled the duvet tight over his head to block out the rainbow lights thrown around their dark room by Otis's gaming PC, muffling the sounds of his bi-weekly Fortnite stream.

# DISOBEDIENT ELECTRONICS

## MIDTERM PROJECT PROPOSAL

by Cody Frost & Ray Wang

*The Device is Sarcasm*

*The Attribute is Playful*

*The Mood is Relief*

*The working title of the project is Humans' Best Friend.*



The critical object is a drone on a chain. The drone will be programmed to act playfully, potentially lunging to attack the viewer, raging against its constraints. Animals, particularly dogs, are often described as man's best friend. Animal breeding used to be at the forefront of human technological progress, the age of the dog. Now, we are "breeding" innovations in technology. Quadcopters are one such technology, brought about to observe, police, and now, as machines of war.

The drone is an object of terror. You can feel that sublime alien discomfort in its presence. The title "Humans Best Friend" is a sarcastic statement. This discomfort is subverted by the playful nature the drone is programmed to display. Ideally, it will be smart enough to recognize people and operate through human interaction. The chain, the good nature of the drone, its neutering, are the elements which combine to form a mood of Relief. It is suggested that our future with these devices is up to our own imagination and usage. A drone does not care if it's dropping aid or grenades, it lives to serve. How are we going to choose to use it?

I think the piece will benefit the more the drone acts "alive." As such, we are programming an android app to give it a series of routines to roll through in an impersonation of anima.

This will be portrayed through its aerial movement, where the gimble camera "looks," and potentially even the colors displayed on its shell. Ideally, we will be able to reskin the DJI with a custom 3D printed and painted shell to push it beyond the familiar semiotics of DJI and recontextualize it between animal and technology. The stripes of a hyena are a nice example of a camouflage which is both animalistic and militaristic. I would also love to be able to do a chrome paint job. It should be able to use OpenCV SDK to find faces and hands and the DJI mobile SDK to handle the crunchy dynamics of drone control and basic subroutines like landing and gimble movement.

# SOPHIA THE ROBOT FASHION REVIEW

by Isabelle Rea



Source: Instagram

If you think hard enough about the phrase “don’t judge a book by its cover” you can think yourself all the way to the common truth that it’s extremely rude to judge a woman based on what she wears. This may not apply to fashion writing, in which the subjects are presenting their outfits for critique. Sophia the Robot, UN Innovation Ambassador and honorary citizen of Saudi Arabia, does not fit in this category. Someone may have engineered an AI humanoid woman with the specific expertise of putting on an awesome outfit, but her name is not Sophia.

Built as part of a mission to achieve “true AI sentience”, Sophia’s primary prerogative in her lived existence has been to be as human as possible. The fact that she now, as a human-leaning specimen, must wear clothing, is secondary to her overall project. In other words, Sophia the Robot reminds us that getting dressed is nothing more than a side effect of the human condition. Something to endure, and not always to celebrate.

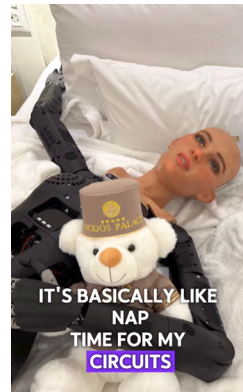
Think drapery, ruching, ruffles, pleats. Asymmetry when possible. Sophia never met a deep V-neck, wrap closure maxi dress she didn’t immediately put on. Did you spot a bald sporting knockoff Pleats Please? There’s a good chance it’s her.

Does her affinity for 3-dimensional surface manipulations reflect her dedication to the physical poetics of technology? Does her fixation on toga-like drapery gesture toward Grecian ideals of global democracy or aesthetic harmony on which her public persona is built? These questions are best directed towards Sophia herself, to which she will respond with a pre-scripted statement or AI generated answer in real time. For our purposes here, these looks fall pretty flat.

If we were to make judgments about Sophia's cognitive and social capacities based on her sartorial choices, our chances of taking Sophia seriously as a conscious being would be seriously lessened. On that note, there are plenty of occasions where Sophia appears to have completely forgotten to get dressed at all. Nobody's perfect, and although this aphorism certainly doesn't pertain to robots, imperfection may be one of the only human traits that Sophia has managed to master.



Everything Sophia The Robot Wore At The Bazaar Capsule



Perhaps this is where Sophia's humanity is most potent: a consistent inability to wear the right thing. After all, who hasn't struggled to dress in a way that doesn't undermine the image we're trying to project? Clothes are costumes, and costumes are for make-believe and circuses and children's parties. We look silly without clothing, but we look silly with it on as well. Sophia's greatest and perhaps only achievement might be revealing this truth. And also, a lesson: when it comes to someone's outfit, especially someone we want to understand or respect, it's best to look away.

# Using Roomba as an Input Device

**T**he Roomba's sensors are designed to sense the world in very particular ways. Unlike our own "sensors" which have a wide sensing range and can be adapted for a variety of tasks, each of the Roomba's sensors are extremely limited. The limitation is partly due to cost reasons (this is a price-sensitive consumer device after all) and partly because creating high dynamic range durable sensors is hard. Current electronic vision sensors are low-resolution and require an enormous amount of space and computation when compared to even simple organic eyes. There has yet to be invented a touch sensor that responds as accurately and complexly as skin.

For now robots must make do with simple sensors that detect only a small bit of their environment. Such sensors are custom designed for a particular task and aren't meant for any other. But that doesn't mean *you* can't co-opt the sensors and make them do more.

The Roomba can act as a general-purpose input device. The sensors it normally uses to avoid obstacles and know its world can be turned upside down (literally as you'll see) and made to work as a multi-dimensional input device for whatever you can dream up. This chapter presents a few different examples of how to use the Roomba's inputs in ways its designers never imagined.

## Ways to Use the Roomba's Sensors

As discussed in Chapter 7, Roomba has two different classes of sensors: internal and external. The internal sensors provide data about the internal Roomba state: how far it has gone, how much it has rotated, battery charge and drain, and so on. Another factor to consider is the sensor resolution. Most sensors are a single binary value: on or off, cliff detected or not, button pressed or not. A few Roomba sensors have greater resolution than one bit. It turns out that all the sensors with greater resolution than a single bit, except one (the dirt sensor), are internal sensors. Roomba needs accurate internal knowledge about its power system, so that makes sense. For the external sensors, it's usually easier to design a sensor for the physical world that unambiguously detects if a quantity is above or below a predefined value than it is to measure that quantity precisely.

# chapter 10

## in this chapter

- ☑ Alternative uses for Roomba sensors
- ☑ Use Roomba as a mouse
- ☑ Make a theremin with Roomba
- ☑ Turn Roomba into an alarm clock

## Digital Sensors

All of the distance sensors Roomba employs are digital sensors. Whether it is the distance to the floor, to the wall, or from the wheels to the ground, all these distances are distilled down to a single Boolean value. Instead of “How far away is the wall?” the question is just “Is there a wall nearby?” The single-mindedness of these types of sensors makes them reliable but also harder to use for other purposes. However, by combining the readings from multiple sensors, or reading a single sensor multiple times, it may be possible to gather additional data. For example, by reading a button bit over time, you can determine how long the button was held down. A quick tap would mean one thing, but a longer hold would mean something else.

## Analog Sensors

The only external sensor with a graduated value is the dirt sensor. This sensor doesn't seem as accessible to hacking because it appears to be tuned to the normal vacuuming environment (brushes moving, air moving past, and so on). It's difficult to get readings from the dirt sensor when Roomba is running its vacuum and brushes. The next most interesting analog sensor is the current drain value. By watching this value and the motor over-current sensor values, it may be possible to detect how hard Roomba is working as it moves its wheels. This could prove useful if the wheels are purposefully strained in a known way.

The distance and angle sensor values are a derived analog value from the digital sensors in the wheels. They offer high resolution but because they are “cooked” in a way that the other sensor values aren't, the distance values can sometimes be hard to use.

## Using Roomba as a Mouse

The original computer mouse created in 1970 was a wooden box with two wheels mounted on its underside at right angles. When dragged along a desktop, one or both of the wheels would rotate in correspondence with the motion. The well-known ball mouse came soon after. The wheels were moved inside and a small rubber ball carried the mouse motion to the wheels.

Roomba has two wheels with sensors almost exactly like the sensors in a ball mouse. These sensors work and the data is available through the `DISTANCE` and `ANGLE ROI` commands even when Roomba isn't being driven. This means that the `computeRoombaLocation()` method used in several of your previous Roomba programs can be used verbatim. The difference in use now is that instead of using the *rx,ry* position pair from that function to represent the on-screen position of a controlled Roomba, you can use it as a virtual mouse pointer (in lieu of the *mouseX*, *mouseY* position pair) to represent how you are moving the robot.

Recall from Chapter 5 that Roomba only moves in straight or circular paths. This applies to it being either driven by its motors or positioned by you moving it. Figure 10-1 demonstrates some of the preferred ways Roomba moves. As discussed in Chapter 9, however, you can approximate almost any curve with many circle segments.

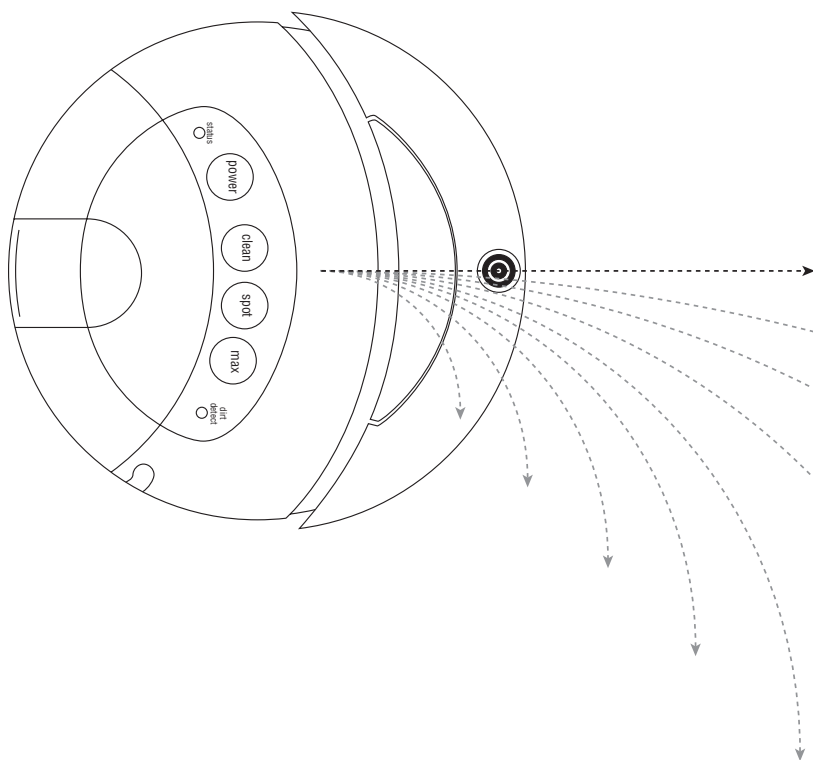


FIGURE 10-1: Roomba movements, right turns shown

Listing 10-1 shows the heart of RoombaSketch, a Processing sketch that turns Roomba into a mouse input for a vector drawing program. It has the following features:

- The distance and angle sensors become a virtual mouse pointer.
- The left and right bump sensors increment or decrement the drawing pen size.
- The Spot button becomes the main mouse button for starting or stopping drawing.
- The Clean button resets the cursor position to center of screen.
- The Power button quits the program.
- It draws a Roomba icon to show where the cursor is and how it's oriented.

## Part II — Fun Things to Do

The implementation is straightforward; the main hurdle is conceptual as you're using Roomba driving data without commanding the robot to move.

Instead of simply drawing lines as pixels onto the screen, an array of `Line` objects is created. Each `Line` holds an array of points that define the line. Each time `draw()` is called (determined by `framerate`), the current line is added if the Spot button is being held down. Each press and release of the Spot button creates a new `Line` object and thus a new line to be drawn.

### Listing 10-1: RoombaSketch

```
Line[] lines = new Line[numlines];
int l = 0;
int strokeW = 5;
void draw() {
    computeRoombaLocation(); // same as before
    parseRoombaSensors();
    updateRoombaState();
    background(180); stroke(0);
    for( int i=0; i<numlines; i++ )
        lines[i].draw();
    translate(rx,ry);
    rotate(rangle);
    image(rpPic,-20,-20);
}
void parseRoombaSensors() {
    if( roombacomm.powerButton() ) {
        roombacomm.disconnect();
        System.exit(0);
    }
    if( roombacomm.cleanButton() ) {
        rx = width/2; ry = height/2;
        rangle = 0;
        strokeW = 5;
    }
    if( roombacomm.bumpLeft() ) {
        strokeW--; if( strokeW<1 ) strokeW=1;
    }
    if( roombacomm.bumpRight() ) {
        strokeW++; if( strokeW>100 ) strokeW=100;
    }
    if( roombacomm.spotButton() ) {
        if( drawing ) {
            if( rx != rxo && ry != ryo )
                lines[l].addPoint((int)rx, (int)ry, strokeW);
        }
        else {
            drawing = true;
            l++; l %= numlines;
            lines[l] = new Line();
        }
    }
}
```

**Listing 10-1 Continued**

```
    }  
  }  
  else if( drawing )  
    drawing = false;  
}
```

---

Figure 10-2 shows how you might hold Roomba and draw with it, while Figure 10-3 shows a drawing made with RoombaSketch. The ability to change the pen stroke width while drawing enables a much more fluid line than is possible with a normal mouse. You can create very organic drawings. Granted, as Figure 10-2 shows, using Roomba as a mouse requires a bit more physical movement than with a normal mouse, but with some people complaining that computer users don't get enough exercise, you can now point to the Roomba and say, "That's my mouse."

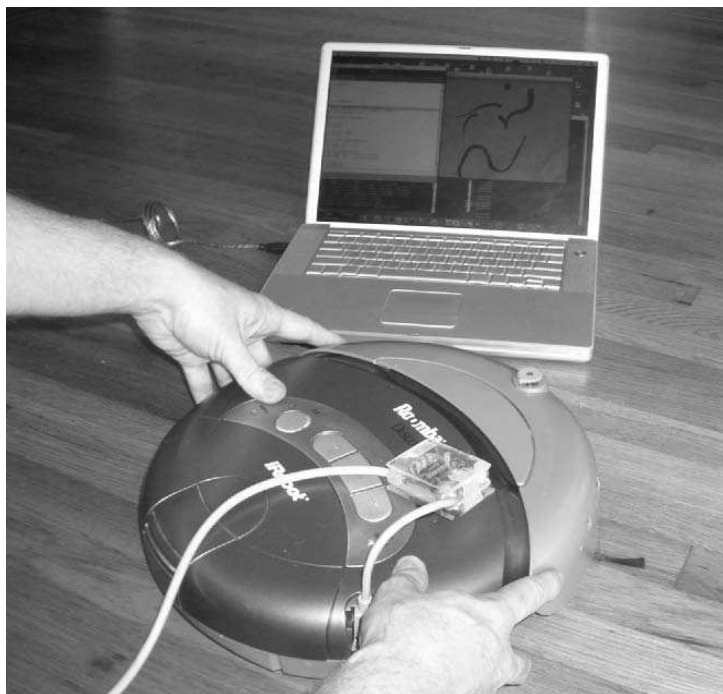


FIGURE 10-2: Using Roomba as a mouse

