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8-5-03

Steve,

Here are most of the clips generated in July on the MEART project. I will keep an eye out for the stories that are still in development.

Thanks for your help and willingness to work with the media. Please keep me updated on any interesting developments.

Larry

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MEART News Coverage (As of August 6, 2003)

Broadcast

CNN

BBC

Science & Technology Magazines

Nature Magazine

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Discover Magazine (October Edition)

Popular Mechanics (October Edition)

New Scientist (in development)

North American Regional Dailies

Washington Times

Toronto Star

Orange Country Register (Santa Ana, CA)

Seattle Post Intelligencer

Palm Beach Post

Atlanta Journal/Constitution

Austin American Statesman

National Post (Canada)

Victoria Times Colonist

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News Wires

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Wired News

ZDNet

International

El Mundo (Spain)

Sydney Morning Herald (July 22 & Aug. 6)

Vista Verde (Italian Newspaper)

Galileo (Italian Newspaper)

Tranfert (French news site)

Przekroj (a large Polish weekly)

Science & vie Junior (a French science magazine for teens)

Engineering Trade Publications

Computing and Science Magazine (IEEE)

IEEE Intelligent Systems

Internet Publications

Better Humans

Sci-Fi Today

Innovations Report

Electronics Weekly

e4engineering.com



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Researchers Use Lab Cultures to Create Robotic 'Semi-Living Artist'

ATLANTA – (July 8, 2003) Working from their university labs in two different corners of the world, U.S. and Australian researchers have created what they call a new class of creative beings, "the semi-living artist" – a picture-drawing robot in Perth, Australia whose movements are controlled by the brain signals of cultured rat cells in Atlanta.

Gripping three colored markers positioned above a white canvas, the robotic drawing arm operates based on the neural activity of a few thousand rat neurons placed in a special petri dish that keeps the cells alive. The dish, a Multi-Electrode Array (MEA), is instrumented with 60 two-way electrodes for communication between the neurons and external electronics. The neural signals are recorded and sent to a computer that translates neural activity into robotic movement.

The network of brain cells, located in Professor Steve Potter's lab at the Georgia Institute of Technology in Atlanta, and the mechanical arm, located in the lab of Guy Ben-Ary at the University of Western Australia in Perth, interact in real-time through a data exchange system via an Internet connection between the robot and the brain cells.

And while the robot's drawings won't put any artists out of business (picture the imaginative scribbling of a three-year-old), the semi-living artist's work has a deeper significance. The team hopes to bridge the gap between biological and artificial systems to produce a machine capable of matching the intelligence of even the simplest organism.

"We're attempting to create an entity that over time will evolve, learn, and express itself through art," said Potter, a professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University.

Potter and his team in the Laboratory for Neuroengineering at Georgia Tech began collaborating with Ben-Ary's team at Western Australia in 2002. They call the robot "MEART," which stands for multi-electrode array art. The project combines the technology of multi-electrode arrays at Potter's lab with the robotic and artistic ingenuity of the team at Western Australia, called the "SymbioticA Research Group."

At the time, Ben-Ary and his group were conducting research into meshing biological technology and artistry in a project called "Fish & Chips." In that project, the team used music to stimulate electrical activity from a few fish neurons cultured on silicon chips, which in turn controlled a robotic arm.

"The goals are both to learn more about how brains work and to apply what is learned to designing fundamentally different types of artificial computing systems," said Ben-Ary, who directs the Image Acquisition and Analysis Facility in the School of Anatomy and Human Biology at Western Australia.

-- more --

Meanwhile, Potter's group was already connecting cultures containing living neurons to computers using multi-electrode arrays that stimulate and record mammalian neurons. Most notably, the group developed the first robotic device whose movements are controlled by a cultured neural network capable of adaptive behavior and learning. They call the hybrid robot a "Hybrot."

The neural activity recorded by the electrodes is transmitted over a two-way communication system and processed both in Atlanta and Perth to control the robotic drawing arm. Depending on how the neuro-electrical activity fires, the robotic arm will draw on a portion of the canvas or choose how many colored markers to use at one time and which colors it will use.

Central to the experiments is Potter's belief that over time the teams will be able to establish a cultured in vitro network system that learns like the living brains in people and animals do. To achieve that, the information from the robot's sensors is sent back through the system to the cultured network of cells in the form of electrical stimuli. By closing the loop, the group hopes the robot will learn something about itself and its environment.

"I hope that this merging of art and science will get the artists thinking about our science, and the scientists thinking about what is art and what is the minimum needed to make a creative entity," Potter said. "On the science side, I hope that we can look at the drawings it makes and see some evidence of learning. Then we can scrutinize the cultured network under the microscope to help understand the learning process at the cellular level."

At the University of Western Australia, the SymbioticA Research Group is managed by Oron Catts and directed by Professors Miranda Grounds and Stuart Bunt in the School of Anatomy and Human Biology. Phil Gamblen developed the robotic arm.

Note: The semi-living artist will be on display at "ArtBots: The Robot Talent Show" (<http://artibots.org>) in New York City July 12 and 13 at the Eyebeam Gallery.

###



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Rat-brained robot does distant art

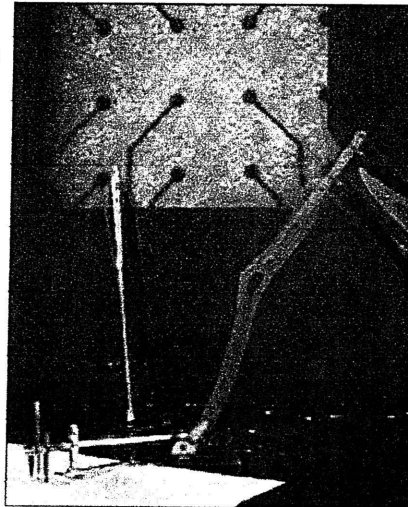
By Lakshmi Sandhana

Meet the latest spaced out modern artist - a picture-drawing robot arm in Australia whose brain sits in a petri dish in the US.

Working from their university labs in two different corners of the world, American and Australian researchers have created what they call a new class of creative beings: "the semi-living artist".

Gripping three coloured markers positioned above a white canvas, a robotic arm churns out drawings akin to that of a three-year-old. Its guidance comes from around 50,000 rat neurons in a petri dish 19,000 kilometres away.

The "brain" lives at Dr Steve Potter's lab at Georgia's Institute of Technology, Atlanta, while the "body" is located at Guy Ben-Ary's lab at the University of Western Australia, Perth.



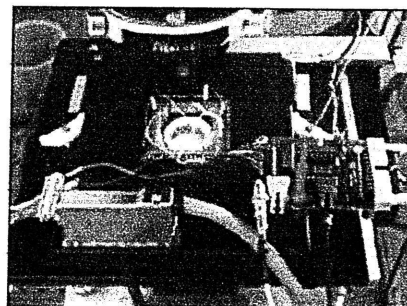
The robot arm is in Perth...

Webcam stimulation

The two ends communicate with each other in real-time through the internet.

The project represents the team's effort to create a semi-living entity that learns like the living brains in people and animals do, adapting and expressing itself through art.

"We are looking at future scenarios where geography won't matter," said Mr Ben-Ary. "The brain of the semi-living could be anywhere in the world, while the body (machine) will interface and be fed off it," he told BBC News Online.



"It really makes you think about the future possibilities, and realise ...but the brain is in Atlanta that the sci-fi vision of movies like Cold Lazarus can turn into reality in the future."

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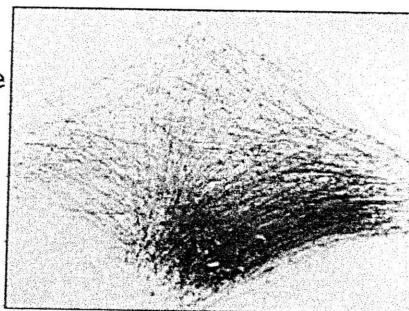
Termed Meart (Multi-Electrode Array Art), the cells are connected via 64 two-way electrodes to a computer and are stimulated by information; in this case transmitting scaled-down images of visitors in its vicinity, captured with a webcam.

Learn a little

The computer translates any resulting neural activity into robotic arm movement. By closing the loop, the researchers hope that the rat culture will learn something about itself and its environment.

"I would not classify [the cells] as 'an intelligence', though we hope to find ways to allow them to learn and become at least a little intelligent," said Dr Potter.

"I look forward to seeing something everyone would call 'learning', but so far, we only have evidence that the system is developing and adapting, such as becoming more controlled - less chaotic over time," he added



Dr Potter hopes the venture will provide valuable insights into how learning occurs at a cellular level.

The drawings are becoming less chaotic

The latest initiative is a development of the SymbioticA Fish And Chips project, in which the artist-scientists grew fish neurons over silicon chips to control a robotic arm that produced drawings and music.

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The Robot Won't Bite You, Dear By Michelle Delio

Story location: <http://www.wired.com/news/technology/0,1282,59622,00.html>

02:00 AM Jul. 15, 2003 PT

NEW YORK -- Nicky Curso was happy that the robots didn't rip off his head.

Spooked by a recent viewing of the blockbuster movie *Terminator 3: Rise of the Machines*, 11-year old Curso was leery about attending *ArtBots*, billed as a talent show for robots, held in New York City this past weekend.

"I thought even good robots could get really angry and bite people or even break people," Curso said. "So I didn't want to be in the same room with any robots."

Fear and loathing of potentially rabid robots and other supposedly sentient technology is exactly what motivated *ArtBots'* organizers to host the show, which brought together 23 robots whose talents ranged from creating art to inspiring affection from passersby.

"I thought that there was an awful lot of attention focused on violent, competitive aspects of robotics," said Douglas Repetto, one of the three curators of *ArtBots: The Robot Talent Show*.

"It's important to me to make the point that a given technology doesn't have a given purpose or application," Repetto said. "It's humans who decide what to use technology for ... who get to decide how this technology is applied to their life."

"Plus it's just really fun. I mean, come on, it's a robot talent show!"

Some of the talents displayed by the robots were pretty impressive indeed.

BabyBott looked like a giant baby bottle and cooed when it was cuddled. Its talent: making people take care of it.

Tribblation, a sort of whiskered soccer ball 'bot, was particularly popular with younger *ArtBots* attendees. Trib has hundreds of pressure, temperature, sound and light sensors, enabling it to respond to stimuli like compliments and stroking.

"I think this robot is a lot cooler than Fred, my cat," said 9-year-old Hannah Nevin of Brooklyn. "Fred only hisses and throws up on the rug."

Also on display was MEART, which stands for multi-electrode array art. MEART is the result of collaboration between U.S. and Australian researchers, who described their project as a prototype of a whole new class of creative beings -- "the semi-living artist."

MEART's movements are controlled by the brain signals of a few thousand cultured rat neurons transmitting to MEART from a petri dish in Atlanta.

The rat neural signals are recorded by 60 two-way electrodes. A computer translates the rodent thoughts into movement and controls MEART's robotic arms, which draw what the rats presumably would draw, assuming they could and would create art.

The resulting artwork is periodically transmitted back to the rat neurons, to provide stimulation and feedback.

As technically impressive as MEART was, some viewers were squeamish about those rat brains.

"Eeeewww," said Shelly Fienstein, a graphic artist who attended the show. "A rat is drawing this stuff? A dead rat? Lots of dead rats? Oh, gross."

LEMUR, the League of Electronic Musical Urban Robots, won the Audience Choice award. A band of robotic instruments that "play themselves," LEMUR features five melodious robots.

The crowd's favorite of the four was ShivaBot, a four-armed, 6-foot-tall robot modeled after the Hindu deity Shiva. ShivaBot, as might be expected from one so physically endowed, plays electronic drums, bells, chimes and cymbals.

A pair of robots known as micro.adam and micro.eva won the Robots' Choice Award, selected as best in show by the competing robots (with a little help from their owners). The two circular robots continuously rotated their bodies, changing their balancing points as they moved and adjusting their path of rotation in response to each other's movements.

The idea of the project was to visually demonstrate how an artificial-intelligence program learns and evolves.

Some of the show's robots will remain on display through Tuesday evening at Eyebeam, a gallery in downtown Manhattan.

The musical LEMUR robots will also make appearances at this week's Macworld CreativePro Conference.



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The brains are alive, but is it still life?

By Bob Keefe
July 22 2003

Who says rats are uncultured vermin?

Researchers at the Georgia Institute of Technology in the US and the University of Western Australia have created a robot that uses the neural impulses of rat brain cells to draw pictures.

The living brains of the device dubbed the Semi-Living Artist stay in Atlanta, where they are nurtured in a petri dish in a lab decorated with a picture of the kitschy robot from the 1960s sci-fi classic *Lost in Space*.

Impulses captured by sensors are sent over the internet to the machine - basically a mechanical arm wired to a computer - making it scribble on the canvas.

The creation recently made its US public debut in New York's Chelsea art district, one of 23 contestants in Eyebeam Gallery's *ArtBots: The Robot Talent Show*.

The Semi-Living Artist is semi-talented at best. The work it produces with its three coloured marker pens isn't exactly *Still-life with Cheese*.

"Basically, it's abstract," says Douglas Bakkum, a Georgia Tech grad student and researcher on the project.

"When you take neurons out of the context they're usually in, they'll express themselves anyway they want . . . Who knows what it's going to look like?"

For Georgia Tech researchers, the art is merely a by-product. The real goal was to study how brain impulses worked together and could be harnessed, Bakkum explained.

Ultimately, the research could be used to help create "neuroprosthetics" such as artificial eyes, eardrums or limbs that blind, deaf or paralysed people could control with brain stimuli.

Some day the research could even be the basis for a new class of thinking, feeling and sensing robots that would bridge biology and robotics.

"I guess in a sense it could be scary, but that's not a reason to avoid it," Bakkum said.

"There's some real beneficial things that could come out of this."

The project originated in the University of Western Australia's Symbiotica laboratory, dedicated to artistic exploration of scientific knowledge and biological technologies.

Georgia Tech became involved after one of its professors, Steve Potter - a self-described product of an artistic mother and scientific father who now specialises in neuronal research - heard about the project.

Cox Newspapers

This story was found at: <http://www.smh.com.au/articles/2003/07/21/1058639723607.html>

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Sydney Morning Herald

August 6, 2003 Wednesday

SECTION: News And Features; Pg. 4

LENGTH: 543 words

HEADLINE: It Didn't Take A Lot Of Grey Matter, But It Is Art

BYLINE: Deborah Smith, Science Writer

BODY:

Its creators regard it as a new class of creative being, one they call a semi-living artist.

It has a robotic arm, developed in Australia, that draws pictures under the control of a collection of brain cells from rat embryos growing in a laboratory in the US.

Body and mind communicate via the internet. And the result, known as MEART, was the toast of a recent exhibition of robot talent in New York, with its portraits of gallery goers.

Guy Ben-Ary, a University of Western Australia team member and artist, admits MEART's drawings, carried out with three-coloured pens, look like the scribbles of a child.

But that is not the point. The aim of the project for the Australian researchers, he said, was to provoke discussion about the differences between cultural and scientific perspectives on what it was to be alive.

Biological technologies were developing at a rapid pace and could lead to the creation of new life forms, he said. "We should think about the consequences. How are we going to treat them, and what kind of relationships will we form with those entities?"

MEART challenges thinking because this mix of living cells and mechanical body appears to evolve, learn and express its experiences through its art.

Dr Ben-Ary said that a couple of days after the New York exhibition, the rat cells they had used suddenly died, and the team mourned their loss.

"We were developing some kind of relationship to the cultures. We wanted to keep them alive; we wanted them to draw more."

The MEART project, which stands for multi-electrode array art, is a collaboration between artists and scientists at the SymbioticA research group in the School of Anatomy at the University of Western Australia, led by Oron Catts, and neuroscientists at the Georgia Institute of Technology, led by Dr Steve Potter.

Thousands of rat neurons are cultured in a special petri dish that contains 60 two-way electrodes.

To "draw" a portrait, a photo of a gallery goer is reduced to a grid of 60 pixels, representing very dark or light spots on the image. This information is converted into electrical signals that are fired into the living cells via the 60 electrodes.

A short time later the natural electrical firing of the cells in response to this stimulation is recorded by the same electrodes and transmitted to the robotic arm, which chooses a mix of pens and a spot on the paper to draw.

An image of the drawing is also fed back to the cells.

Dr Ben-Ary said this was to simulate real life, in which an artist would look at a subject, make a few pen marks and then compare the work in progress with the subject again.

Gallery goers at Artbots: The Robot Talent Show in New York last month were particularly intrigued by the fact the brain cells were thousands of kilometres away in Georgia, he said.

The team hopes to exhibit the robot in eastern Australia and is considering getting it to do other things, such as sculpt.

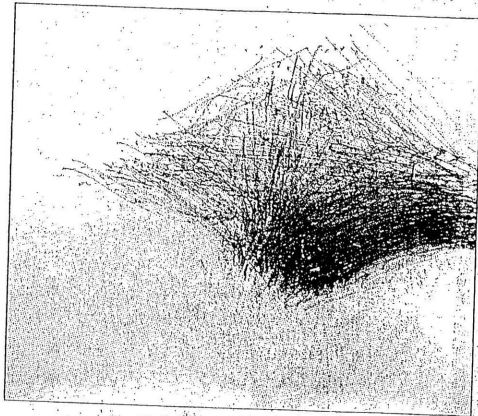
Dr Potter's US team is also interested in understanding how brain cells interact in order to learn from experience.

In a previous project, known as Fish and Chips, the Australian team used music to stimulate a few fish brain cells growing on silicon chips, which then generated signals that moved a robotic arm.

LOAD-DATE: August 5, 2003

Rat brains, robotics linked to create 'semi-living' art

By BOB KEEFE
Cox News Service



University of Western Australia handout.

This drawing is the work of a 'Semi-Living Artist,' a robot that uses the neural impulses of rat brain cells to draw pictures. Researchers in Georgia and Australia built the 'ratbot'.

Who says rats are uncultured vermin? Researchers at the Georgia Institute of Technology and the University of Western Australia have created a robot that uses the neural impulses of rat brain cells to draw pictures.

The living brains of the device, dubbed the "Semi-Living Artist," stay in Atlanta, where they are nurtured in a petri dish in a lab decorated with a picture of the kitschy robot from the 1960s sci-fi classic *Lost in Space*.

Impulses captured by sensors are sent over the Internet to the machine, which is basically a mechanical arm wired to a computer, making it scribble on the canvas.

This weekend, the creation makes its U.S. public debut in New York's Chelsea art district, one of nearly 25 contestants in Eyebeam Gallery's "ArtBots: The Robot Talent Show."

The "Semi-Living Artist" is semi-talented at best. The work it produces with its three

colored markers isn't exactly *Still Life With Cheese*.

"Basically, it's abstract," said Douglas Bakkum, a Georgia Tech grad student and researcher on the project.

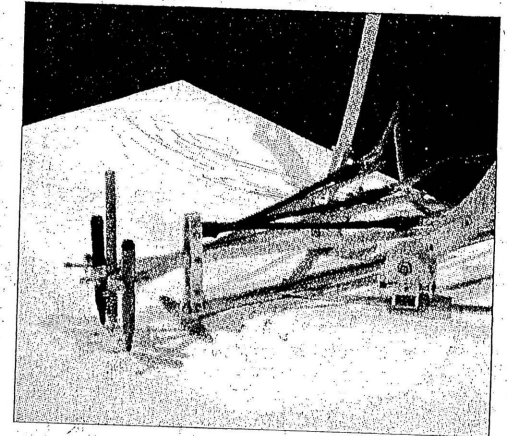
"When you take neurons out of the context they're usually in, they'll express themselves anyway they want," Bakkum said. "Who knows what it's going to look like?"

For Georgia Tech researchers, the art is merely a byproduct. The real goal is to study how brain impulses work together and can be harnessed, Bakkum explained.

Ultimately, the research could be used to help create "neuroprosthetics" such as artificial eyes, eardrums or limbs that blind, deaf or paralyzed people could control with brain stimuli.

Someday, the research could be the basis for a new class of thinking, feeling and sensing robots bridging biology and robotics.

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University of Western Australia photo

The robotic drawing arm operates as sensors capture the impulses of a few thousand rat neurons in a special petri dish that keeps the cells alive. The impulses are sent over the Internet.

Friday July 11, 2003.

Culture/The United States/Numerical Oceania/Creation/Research

Distributed neuronal art takes its first steps in New York



When a brain of culture is used as creative conscience with a robot draughtsman...

<http://www.transfert.net/a9116> | return

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The very new shape of " *bio-cybernetic* " creature will be presented during the exposure ArtBots 2003 , which will be held this weekend in New York. The MEART (Multi Electrode Array Art) consists of a robotized tracing arm connected by Internet to a culture of neurons of rat located at several kilometers. According to his originators, this artificial artist, semi-alive semi-numerical, will allow to better include/understand the neurological bases of the creativity.

The idea of MEART was born from the meeting in 2002 between the artist Guy Ben-Ary of SymbioticA Research Group of [the university of Australia occidentale><http://www.uwa.edu.au/>] and of an American neurobiologist, Steve Potter, of Wallace H. Coulter Department of Biomedical Engineering of Georgia Tech and Emory University in Atlanta. The project consists in combining the technique of the multielectrode grids (MEA) of Potter' S Group, which makes it possible to inter-connect living tissue and electronic instruments, with the artistic and robot-like achievements of the Australian team of SymbioticA.

Self-adaptation and spontaneous creation

The robotized arm, developped at the point in Australia, draws using three coloured markers. Its displacements are controlled from the United States by the electric impulses emitted by neurons cultivated on a MEA. The electric signals transmitted by the MEA are réencodés before being transmitted by Internet to the case of ordering of the arm draughtsman. As for the brain, it " *gets informed about the world* " by the electric impulses returned by the case of the robot towards the MEA.

For the specialists in the brain, this kind of "sensorimotor" loop is the neurological base of the intelligence and the conscience . According to its originators, the loop between the brain and the arm of the MEART make this last capable of self-adaptation and spontaneous creation. What makes the first prototype of autonomous robot-artist of it, evolutionary and dissociated geographically. For the moment, its first "drawings" hold more those of gifted nourrisson that of Rembrandt, but the brain of culture is still very young and it is able to learn.

The MEART will carry out several performances during the ArtBots exposure which will be held with the Eyebeam gallery of nearest New York July the 12 and 13. Ben-Ary and Potter hope to benefit from the exposure to improve the "feature" of their cyber-dream while returning to his brain the image in real time of the faces of the witnesses filmed during the graphic performances of the robot.

Works of MEART:

<http://userwww.service.emory.edu/ashkoln/meart/>

To contact the drafting

Yaroslav Pigenet

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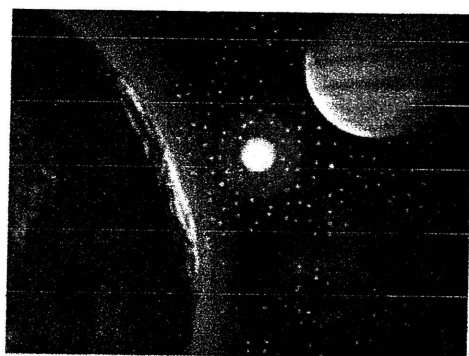
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ASTRONOMY

Matusalemme Planet

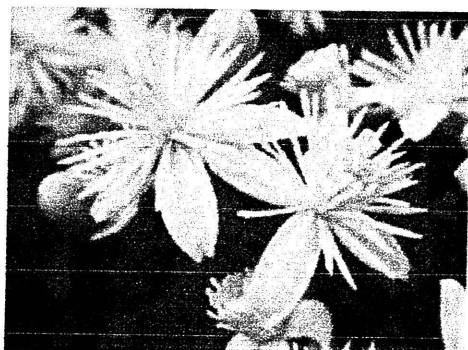


A planet "Matusalemme". Orbit around two died stars, pulsar and a dwarf white woman, in the M4 heap and has an estimated age of 12,7 billions of years. That is nearly three times a lot the medium age of the Earth and planets discoveries up to now to outside of Solar Sistema, little more than a hundred. The discovery, realized from a team of American astronomers, supports to you from NASA, with the surveys of the Hubble Space Telescope, it could force to us to rethink our acquaintances on the formation of planets, and even on the age of the Universe. The globular heap M4, distant 5,600 light years from the

Earth, is constituted from a group of ancient stars much (than the astronomers they classify like "first generation"), you form yourselves ago approximately 13 billions of years: up to now the scientists had thought impossible the formation of planets to this stage of evolution of the Universe (whose age comes estimated in 13,7 billions of years), because of the insufficient presence of heavy chemical elements, like iron and silicon. Abundant material, instead in stars of successive generation, like our Sun (one star of third generation). The existence of this gigantic planet of gaseous, invisible nature also to the eye of the telescope, has been comprised to leave from the irregolarità in marks emitted them from the pulsar. (m.mo.)
(11 fridays July)

GENETICS

Unexpected relationships

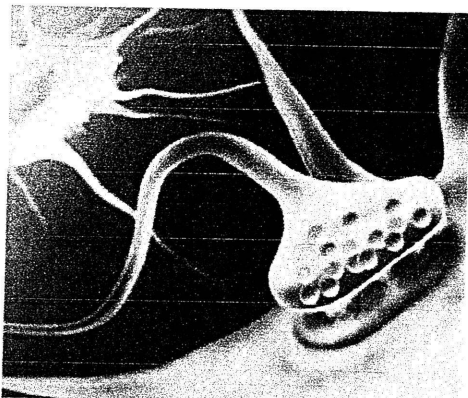


Next to along it has been believed that it was not possible. Or better than capittasse a lot than I shave, like one species of extraordinary event. Hour but a study of the University of Indiana asserts that the exchange of geniuses between individuals does not correlate to you, pertaining that is to species various, is not only possible but he is also much probable one. The study, published on Natures and coordinated from Jeffrey Palmer, has taken in consideration the mitochondriale Dna of a hundred of angiosperms (plants with seeds enclosed and protect from a covering). The search of likenesses between the

sequences of geniuses has lead the scientists to an amazing result: some plants from

NEW TECHNOLOGIES

Generation hybrot



A painter of vanguard, po' a rat po' a robot. From a part, in an American laboratory, there are some thousand of neurons of rat in cultivation, from which leave of the impulses electrical workers elaborates to you from a computer; from the other, to several migliaia of distance kilometers, in an Australian center of search, a robotico arm moves over one burlap, commant from a computer connected via Internet to those North Americans. Meart is called (Array fines-electrode art), has been realized from the group of Steve Potter to the Georgia Institute of Technology of Atlanta in collaboration with the team of Guy Ben-Ary of the University of Australia Western to

Perth. The year slid from the group of Atlanta continues therefore the under way tradition of searches, that hybrid-robot has coined the word "hybrot" () in order to describe these half-alive systems. "the objective is that one to create an entity that with the time evolva, learns and it is expressed with the art", Potter explains. In fact the information does not travel solo from the neurons to the robotico arm, but also in contrary sense: from the sensors you mail on the mechanical arm in fact leave of give you that they reach the nervous cells under shape then of marks them electrical workers, thanks to the bidirectional electrodes that concur the communication between the biological material and the electronic apparatuses. "the objective is double", explains Guy Ben-Ary, "to better comprise the operation of the brain and to take advantage of these new acquaintances in order to develop various types of systems of artificial intelligence". (m.mo.)
(9 Wednesdays July)

MENTAL DISEASES

If the virus it hits the brain

Discovered one new relation between virus and mental diseases. The study, lead from a group of investigators of the Japanese university of Osaka and published on "Proceedings of the National Academy of Sciences", confirmation studies epidemiologists already carries out to you previously. The experiment has demonstrated that rats to which it has been inserted an able gene to synthetize a protein normally produced from the Borna virus (Bdv), a pathogenic one associated to some shapes of depression and schizophrenia, introduce symptoms similar to those founds in human the mental diseases, like detached aggressiveness, iperattività and deficit to neurological levels. The coordinator of the group of search, Keizo Tomonaga, explains that the protein turns used them in the test hits some cells of the central nervous system altering them of the ability to synthesis and control of the nervous joints. Tomonaga is convinced that the Bdv can act analogous in human the nervous system. The result is moreover estendibile to all the infections due to single proteins turns them, like the influence and the Hiv, and represents a step in ahead in the study of the mental diseases and of the role that the infections turns they have them in their origin (a.st.)
(9 Wednesdays July)

BIRDS

The migratore intestine

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- 09,07,2003 -

Artificial intelligence:**Rat brain cells steer indication robots**

Australian and US-American scientists have a "new class of creative organisms" according to own data to create.

(jkm) - the researchers use neural signals of rat brain cells in Atlanta, in order to let with the data in the Australian Perth a bionic arm of pictures draw. The works of the "halfiving artists" are brought over three felt-tip pens on the canvas.

More informati

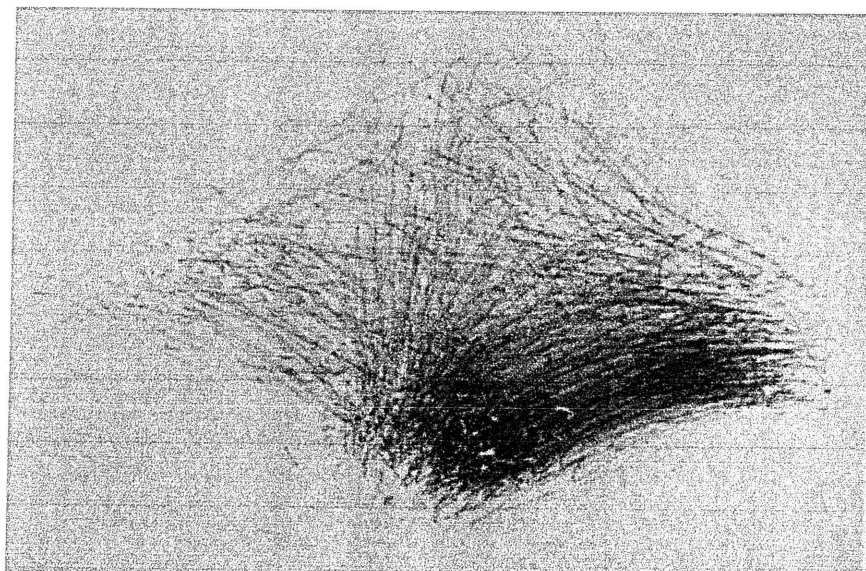
Georgia of ins
Technology

"Semi living a:

MEART

Artbots

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possible - onlyFun and Ernst
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© Georgia of institutes OF Technology

A work of the "halfiving artists"

The idea was born at the Georgia institutes OF Technology in Atlanta. A group of researchers around Steve Potter consulted some thousand brain cells of rats as laboratory culture and interlaced it with 60 electrodes, which pass the brain signals on to a computer. This

translates the data into instructions, which are sent over the InterNet to a bionic arm at the University OF Western Australia in Perth. "we want to create something the fact that freely it develops and over the art learns itself to express", explains Potter.

The American took up therefore contact to the Australian group around Guy Ben Ary, which already made Fish & chip "headlines with the project". The researchers had settled individual nerve cells of fish on a silicon chip and had used their signals for the controlling of a bionic arm. From the new project the Australians expect suggestions for the development of artificial intelligence. They send signals of their robot sensors back to the laboratory in Atlanta, where the data are converted into electrical impulses for the rat cells. The brain cells will learn, hope something on a long-term basis over the robot and its environment the researchers. They expect that this learning process can be read off then from the designs.

The fact that artists of a daily are replaced by robots does not stand to fear. The researchers grant critically, the pictures of the rat cells reminded them of scribbles of three-year ones. They place its project MEART - for "multi electrode array kind" - on the robot talent Show "Artbots" at 12. and 13. July in New York forwards.

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Times Colonist (Victoria)

July 13, 2003 Sunday Final Edition

SECTION: Arts; Pg. B10**LENGTH:** 370 words**HEADLINE:** Rat cells meld with robot to create 'semi-living artist': Machine uses brain impulses to scribble work on canvas**SOURCE:** Cox News Service**BYLINE:** Bob Keefe**BODY:**

Who says rats are uncultured vermin?

Researchers at **Georgia Institute** of Technology and the University of Western Australia have created a robot that uses the neural impulses of rat brain cells to draw pictures.

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Ultimately, the research could be used to help create "neuroprosthetics" such as artificial eyes, eardrums or limbs that blind, deaf or paralysed people could control with brain stimuli.

Someday the research could even be the basis for a new class of thinking, feeling and sensing robots that would bridge biology and robotics.

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JULY 12, 2003



313

Bacon's

Robot art shows rat-brain activity

'Semi-Living Artist' melds robotics and rodent cells into drawings.

By BOB KEEFE
COX NEWS SERVICE

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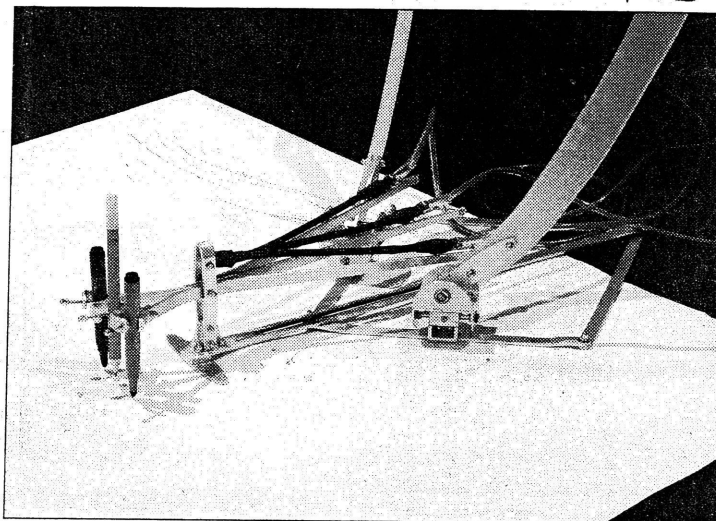


PHOTO: UNIVERSITY OF WESTERN AUSTRALIA

NEW YORK-BOUND: Robotic drawing arm operates based on the neural activity of thousand of rat neurons placed in a petri dish. Results will be entered in a New York robot talent show.

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JULY 15, 2003



Bacon's

3113 P08
**Device weds
rat brains,
robotics**

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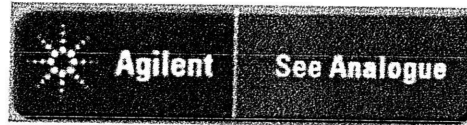
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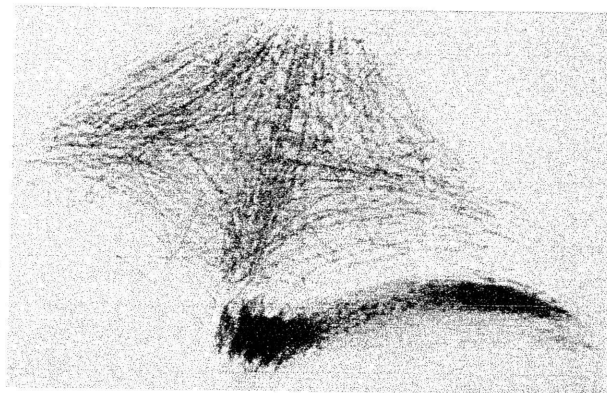
ElectronicsWEEKLY.com

Rat's neurones in nutrient vat doodle picture

Steve Bush

This is an image drawn by a few isolated rat neurons controlling a pen-equipped robot arm.

"The arm was drawing the diamond shape [top of the image]," said the Multi-electrode Array Art team at the University of Western Australia. "After 30 minutes we stimulated it. The result was a change in the drawing [lower right side area]."



Stimulation to the neurones came from a pixelated photograph fed over a two-way Internet link to an array of 60 electrodes in the nutrient dish where the neurones live, at the neuroengineering lab of the Georgia Institute of Technology.

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Jul. 14, 2003. 01:00 AM

Rat brain cells fuel robot's art

Internet sends neural impulses to mechanical arm

Project's real goal to study how brain impulses work

BOB KEEFE

SPECIAL TO THE STAR

ATLANTA—Who says rats are uncultured vermin?

Researchers at Georgia Institute of Technology and the University of Western Australia have created a robot that uses the neural impulses of rat brain cells — via the Internet — to draw pictures.

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By Alex Cukan

United Press International

'GRANNY GRABBERS' SELLING WELL

They are called granny grabbers, children's clothing so adorable grandparents can't resist buying them, but parents have been grabbing them as well.

While children's clothing grew 6 percent in 2002, the rest of the apparel sector has been flat or dropped, TIME magazine reports.

War and terrorism have created a desire among many parents to protect and pamper their children, says Erin Clack, market editor of the trade publication Children's Business.

For example, Cheryl Kilton, spent \$200 on a Christmas dress trimmed in mink with matching fur shoe clips and headband for her 2-year-old daughter.

-0-

THE COLLAPSIBLE HEEL

High heels slim women's calves, improve posture and add glamour to an outfit but they also can cause blisters, bunions and the danger of taking a spill.

One shoe company had to withdraw 3-inch titanium spike heels after it feared the wearer might have the heel go straight through if they stood on someone's foot, The Scotsman reports.

A British design student, 22-year-old Ella Kilgour, has invented a solution to the style or comfort dilemma of millions of women -- the collapsible stiletto.

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Kilgour, a product design graduate from Brunel University in London, says she had the idea after getting blisters herself. Her shoe is made of leather, a resin base and a collapsible aluminum heel.

-0-

BEAUTICIAN DOES MORE THAN HAIR

Zahira Zahir, hair clipper of America's commanders in chief, does more than clip hair and do nails.

Her full-service salon at the Watergate Hotel in Washington, D.C., provides grooming services to members of both sides of the aisle, as well as President George Bush, but she is also on a mission.

She raises money for educating girls in her homeland of Afghanistan.

A beautician, her employer cut the hair of former President Ronald Reagan and she did his nails. Ever since she's been giving Washington politicians an earful on Afghanistan, The Washington Post reports.

"I raised money to rebuild the school that made me what I am and went home for the first time since 1975 with \$216,000," she says of her recent trip to the capital, Kabul.

-0-

ROBOT ARTISTS CONTROLLED BY RAT CELLS

U.S. and Australian researchers have created what they call a new class of creative being -- a semi-living artist.

MEART is a picture-drawing robot in Perth, Australia, whose movements are controlled by the brain signals of cultured rat cells in Atlanta.

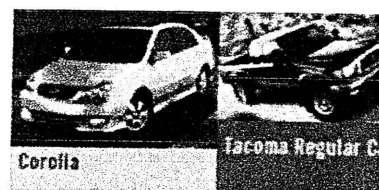
The robotic drawing arm operates based on the neural activity of a few thousand rat neurons placed in a special petri dish that keeps the cells alive.

While the robot's drawings won't put any artists out of business -- think toddler scribbling -- the semi-living artist's work has a deeper significance, researchers say, in bridging the gap between biological and artificial systems.

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Saturday, July 12, 2003

If rats could draw, it might look like this ...

By BOB KEEFE
COX NEWS SERVICE

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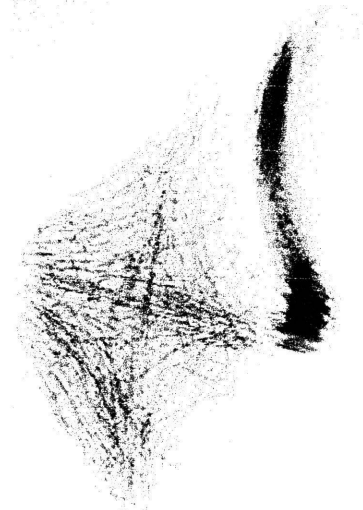
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Artbots show talent

Brain cells draft portraits via robot more than a thousand kilometers away.
15 July 2003

HELEN PEARSON



They may look like mindless scrawls. But the portraits sketched by a robotic arm in New York's Eyebeam gallery are actually the creation of brain cells - growing more than 1,300 kilometres away.

The cultured culture - entitled MEART - is staring in ArtBots: The Robot Talent Show in Manhattan's Chelsea art district. The exhibition showcases artists' increasing use of electronic and mechanical robotic technology.

Culture shock: brain cells in Atlanta drew this portrait in New York.

© MEART

books, explains the exhibition's curator Douglas Repetto. He plans to make Artbots an annual event.

MEART is the product of a collaboration between Symbiotica, an art-science group led by Guy Ben-Ary of the University of Western Australia in Perth, and Steven Potter's neuroscience lab at the Georgia Institute of Technology in Atlanta.

Its spider-like hinged arm is connected via the Internet to a dish of embryonic rat brain cells growing in Potter's Atlanta lab. The cells live on a grid of 64 electrodes called a multi-electrode array (MEA) that fires electrical signals into the cells - or detects those that shoot naturally along them.

Visitors to the gallery are invited to pose for MEART. A digital

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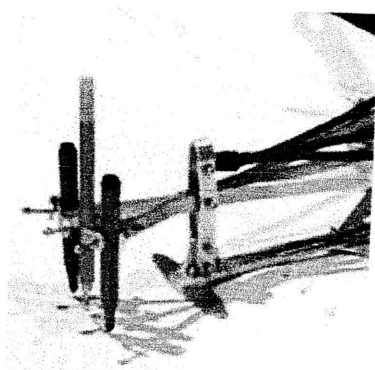
image of MEART's initial doodles is subtracted from a digital photo of them. The difference between the images is converted into a grid of 64 pixels; a high-value pixel represents a spot that is dark on the original but remains blank on the paper.

Every second, the 64 pixel values are beamed to the growing brain cells, converted into electrical signals and zapped into them via the corresponding 64 electrodes. After a pause, each electrode then measures the electrical signals generated by the nerve cells' in response to the stimulation, and shoots this information back to the robotic arm.

High electrical activity in one region of cells sends the robotic arm towards the corresponding area of the canvas to scrawl with one of three pens. "They are scribbles," concedes Ben-Ary, "but aesthetically they're beautiful."

Live and learn

MEART's sketchy efforts "are definitely furthering the science", says Atlanta lab member Douglas Bakkum. The team is trying to figure out how groups of nerve cells communicate and learn like a fully formed brain.



Using data collected throughout the show, Bakkum hopes to work out whether, for example, cells that are stimulated the most also respond more and hence direct the pen to an empty spot. These patterns are hard to tease out because of impulses that travel between the interconnected nerve cells.

Signals from the nerve cells guide the robot arm.

© MEART

Science aside, MEART's portraits are already winning fans in the art world. They will go on display at another New York gallery, The Tank, on 17 July. And the project is a strong contender for the robotic equivalent of the Turner prize - ArtBots visitors and artists are voting for their favourite machine.

© Nature News Service / Macmillan Magazines Ltd 2003

Robots bring out rats' left-brain art talent

By BOB KEEFE
bkeefe@ajc.com

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"When you take neurons out of the context they're usually in, they'll express themselves any way they want," Bakkum said. "Who knows what it's going to look like?"

For Georgia Tech researchers, the art is merely a byproduct. The real goal is to study how brain impulses work together and can be harnessed, Bakkum explained.

Ultimately the research could be used to help create neuroprosthetics, such as artificial eyes, eardrums or limbs that blind, deaf or paralyzed people could control with brain stimuli.

Someday the research could

even be the basis for a new class of thinking, feeling and sensing robots that would bridge biology and robotics.

"I guess in a sense it could be scary, but that's not a reason to avoid it," Bakkum said. "There's some real beneficial things that could come out of this."

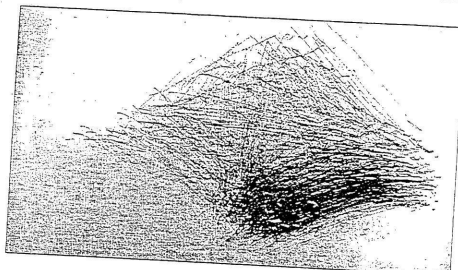
The project is the brainchild of Georgia Tech professor Steve Potter, a self-described product of an artistic mother and a scientific father who now specializes in neuronal research. The Semi-Living Artist — researchers also call it a "Hybrot" because of its hybrid nature — was born after a biologist/artist at the university in Perth heard Potter speak about his research.



Georgia Tech
A few thousand rat neurons are placed in a special petri dish to keep them alive to operate the robotic drawing arm.



University of Western Australia



Directed by neural impulses from the rat brain cells, a robotic drawing arm (above) creates a picture like some that are going on display in New York. The "Semi-Living Artist" computer project is the brainchild of Georgia Tech and University of Western Australia researchers.

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BETTERHUMANS

Rat Brain Cells Draw with Robot Arm

Dwayne Hunter
Betterhumans Staff

Thursday, July 10, 2003, 10:40:51 AM CT

Rat brain cells in a US lab are painting pictures with a robot arm in Australia in a project aimed at creating and understanding a hybrid entity that can learn and express itself through art.

The neural activity of a few thousand rat neurons in a special cell-sustaining petri dish controls the arm.

The arm grips three colored markers above a white canvas and draws on different portions of the canvas with different combinations of colors depending on the neurons' electrical activity.

The petri dish contains a multi-electrode array with 60 two-way electrodes that allow communication between neurons and external electronics.

A computer translates the neural activity of the brain cells, which are located in Steve Potter's lab at the Georgia Institute of Technology in Atlanta, into movements for the robotic arm, which is located in the lab of Guy Ben-Ary at the University of Western Australia in Perth.

Movements are transmitted in real time through the Internet.

Scribbles like a three-year-old child

Although the robot's drawings are similar to those of a three-year-old child's scribbles, the so-called "semi-living artist" is significant because it's a step towards bridging the gap between biological and artificial systems.

The work could soon lead to hybrid machines capable of matching the intelligence of simple organisms.

"We're attempting to create an entity that over time will evolve, learn, and express itself through art," says Potter.

Fish, chips and Hybrot

Prior to this project, Ben-Ary and his team were working on one called "Fish & Chips" that used music to stimulate electrical activity in fish neurons on silicon chips, which in turn controlled a robotic arm.

At the same time, Potter and his team were developing the first hybrid robotic device, the "Hybrot," which is controlled by a cultured neural network capable of adaptive behavior and learning.

The new robot, which has been called "MEART" for "multi-electrode array art," is a product of a collaboration between Potter and Ben-Ary that began in 2002.

The project combines the technology of multi-electrode arrays at Potter's lab, the Laboratory for Neuroengineering, with the robotic and artistic specialization of Ben-Ary's team, called the SymbioticA

Research Group.

"I hope that this merging of art and science will get the artists thinking about our science, and the scientists thinking about what is art and what is the minimum needed to make a creative entity," says Potter.

"On the science side, I hope that we can look at the drawings it makes and see some evidence of learning. Then we can scrutinize the cultured network under the microscope to help understand the learning process at the cellular level."

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Researchers use lab cultures to create robotic artist

Working from their university labs in two different corners of the world, US and Australian researchers have created what they call a new class of creative beings, 'the semi-living artist' - a picture-drawing robot in Perth, Australia whose movements are controlled by the brain signals of cultured rat cells in Atlanta.

Gripping three coloured markers positioned above a white canvas, the robotic drawing arm operates based on the neural activity of a few thousand rat neurons placed in a special petri dish that keeps the cells alive.

The dish, a Multi-Electrode Array (MEA), is instrumented with 60 two-way electrodes for communication between the neurons and external electronics. The neural signals are recorded and sent to a computer that translates neural activity into robotic movement.

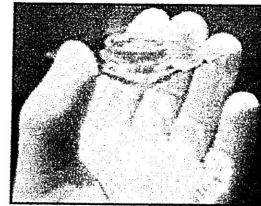
The network of brain cells, located in Professor Steve Potter's lab at the Georgia Institute of Technology in Atlanta, and the mechanical arm, located in the lab of Guy Ben-Ary at the University of Western Australia in Perth, interact in real-time through a data exchange system via an Internet connection between the robot and the brain cells.

The team hopes to bridge the gap between biological and artificial systems to produce a machine capable of matching the intelligence of even the simplest organism.

'We're attempting to create an entity that over time will evolve, learn, and express itself through art,' said Potter, a professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University.

The neural activity recorded by the electrodes is transmitted over a two-way communication system and processed both in Atlanta and Perth to control the robotic drawing arm. Depending on how the neuro-electrical activity fires, the robotic arm will draw on a portion of the canvas or choose how many coloured markers to use at one time and which colours it will use.

Central to the experiments is Potter's belief that over time the teams will be able to establish a cultured in vitro network system that learns like the living



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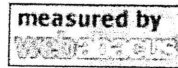
'The goals are both to learn more about how brains work and to apply what is learned to designing fundamentally different types of artificial computing systems,' said Ben-Ary, who directs the Image Acquisition and Analysis Facility in the School of Anatomy and Human Biology at Western Australia.

The semi-living artist will be on display at ArtBots: The Robot Talent Show in New York City July 12 and 13 at the Eyebeam Gallery.

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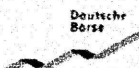
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Georgia Institute of Technology Research News

Researchers use lab cultures to create robotic 'semi-living artist'

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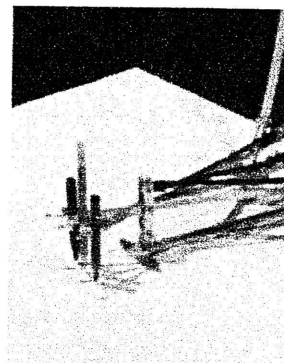
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"We're attempting to create an entity that over time will evolve, learn, and express art," said Potter, a professor in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University.

Potter and his team in the Laboratory for Neuroengineering at Georgia Tech teamed up with Ben-Ary's team at Western Australia in 2002. They call the robot "MEART," multi-electrode array art. The project combines the technology of multi-electrode arrays from Potter's lab with the robotic and artistic ingenuity of the team at Western Australia's SymbioticA Research Group.

At the time, Ben-Ary and his group were conducting research into meshing biology and artistry in a project called "Fish & Chips." In that project, the team used multi-electrode arrays to record electrical activity from a few fish neurons cultured on silicon chips, which in turn controlled a robotic arm.



The robotic drawing arm operates based on the neural activity of a few thousand rat neurons placed in a special petri dish that keeps the cells alive.



Researchers are using a Multi-Electrode Array (MEA) to electrically stimulate and record the electrical activity of neurons grown inside the cylinder area.



"The goals are both to learn more about how brains work and to apply what is learned to designing fundamentally different types of artificial computing systems," said Beards. He directs the Image Acquisition and Analysis Facility in the School of Anatomy and Physiology at Western Australia.

Meanwhile, Potter's group was already connecting cultures containing living neurons to computers using multi-electrode arrays that stimulate and record mammalian neurons. Notably, the group developed the first robotic device whose movements are controlled by a cultured neural network capable of adaptive behavior and learning. They call the device "Hybrot."

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At the University of Western Australia, the SymbioticA Research Group is managed by Professor Catts and directed by Professors Miranda Grounds and Stuart Bunt in the School of Human Biology. Phil Gamblen developed the robotic arm.

Note: The semi-living artist will be on display at "ArtBots: The Robot Talent Show" (<http://artbots.org>) in New York City July 12 and 13 at the Eyebeam Gallery.

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09.07.2003 | Larry Bowie | Quelle: Georgia Tech

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Georgia Institute of Technology Research News

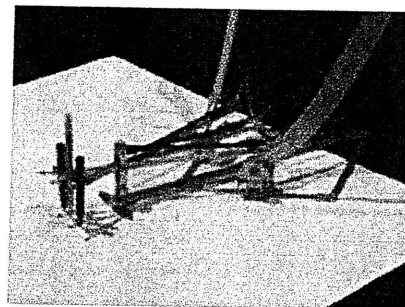
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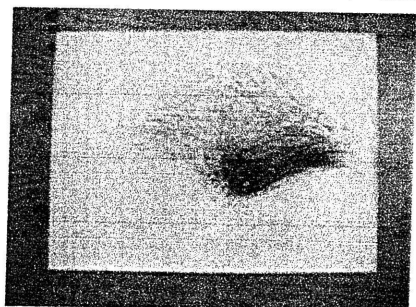
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Full size image available through contact



A picture drawn by the "semi-living artist."

Full size image available through contact

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Researchers Use Lab Cultures to Create Robotic 'Semi-Living Artist'

ATLANTA, July 8 (AScribe Newswire) -- Working from their university labs in two different corners of the world, U.S. and Australian researchers have created what they call a new class of creative beings, "the semi-living artist" - a picture-drawing robot in Perth, Australia, whose movements are controlled by the brain signals of cultured rat cells in Atlanta.

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Australian rat-robot hybrid paints pictures

James Pearce, ZDNet Australia

A Western Australian art and science collaboration is assisting US neuroengineers with the development of distributed networks and artificial intelligence.

The SymbioticA Research Group (Sarg) is a collection of artists, computer programmers and scientists based at the University of Western Australia. It has collaborated with the Laboratory for Neuroengineering at Georgia Tech in the US, which recently hooked a few thousand rat neurons to a multi-electrode array to create a 'Hybrot' -- so named because it is a hybrid of living and electronic components.

Sarg had already done some research in creating art using fish neurons, so the two laboratories decided to collaborate in an attempt to bridge the gap between biological and artificial systems, to produce a machine capable of matching the intelligence of even the simplest organism -- one that will over time evolve, learn, and express itself through art, according to Professor Steve Potter.

The US hybrot was linked over the Internet to a robotic arm with three coloured pens created by Sarg that responded to electrical signals from the hybrot; the first time neurons over an electrode array have communicated over the Internet to a remote location. "The areas of activity in the neural culture respond to [movements] in the robotic arm," Oron Catts, artistic director of Sarg, told ZDNet Australia. "For example, if the upper left area of the neural culture activates, the arm moves that way."

The resulting robot is called "Meart," which stands for multi-electrode array art. Catts said there was a feedback loop so the neurons could "see" what they were drawing. "The culture is fed with the original image, the portrait that they are trying to produce, and what they have drawn already, so they can subtract the image," he said.

Potter believes that the teams will be able to establish a cultured in vitro (literally "in glass") network system that learns in the same way as the living brains in people and animals: in effect, creating artificial intelligence by using the building blocks of living brains.

"On the science side, I hope that we can look at the drawings it makes and see some evidence of learning," said Potter. "Then we can scrutinise the cultured network under the microscope to help understand the learning process at a cellular level."

Catts, on the other hand, is more interested in the artistic and philosophical aspects of the experiment. "I'm interested in creating a cultural discussion questioning the gap between the cultural understanding of life and the scientific understanding of life," he said, saying that other people who worked at Sarg had different interests in the project. "[We're also] interested in raising the broader issue of using living tissues in areas they are not meant to be used."

"Being creative and artistic is something that has traditionally been reserved for [humans and other higher life forms]... [we're trying to] create something that can be perceived by others as creative," said Catts. The choice of words is significant, since

<http://news.zdnet.co.uk/cgi-bin/uk/printerfriendly.cgi?id=2137335&tid=269>

7/11/2003

the human input into the artworks is integral. Humans not only created the robotic arm, but also wrote the software to interpret the neural signals generated by the rat cells, and provide input to the cells in terms of electrical impulses.

"We're walking the line," admitted Catts, claiming that part of their role as artists was to explore boundaries and be confronting. "It's not about the shock value of the work but about raising questions."

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National Post (Canada)

July 14, 2003 Monday National Edition

SECTION: Discovery; Pg. A11**LENGTH:** 375 words**HEADLINE:** Science taps in to creative side of rats: From Petri dish to finished canvas, via the Internet**SOURCE:** Cox News Service**BYLINE:** Bob Keefe**BODY:**

Who says rats are just uncultured vermin?

Researchers at **Georgia Institute** of Technology and the University of Western Australia have created a robot that uses the neural impulses of rat brain cells to draw pictures.

The living brains of the device dubbed the "Semi-Living Artist" stay in Atlanta, where they are nurtured in a Petri dish in a lab decorated with a picture of the kitschy robot from the 1960s sci-fi classic *Lost in Space*.

Impulses captured by sensors are sent over the Internet to the machine -- basically a mechanical arm wired to a computer -- making it scribble on the canvas.

This weekend, the creation made its U.S. public debut in New York's Chelsea art district. It was one of nearly 25 contestants in Eyebeam Gallery's "ArtBots: The Robot Talent Show."

The "Semi-Living Artist" is semi-talented at best. The work it produces with its three coloured markers is not exactly *Still Life With Cheese*.

"Basically, it's abstract," said Douglas Bakkum, a graduate student at **Georgia Tech** and a researcher on the project.

"When you take neurons out of the context they're usually in, they'll express themselves anyway they want," Bakkum said. "Who knows what it's going to look like?"

For **Georgia Tech** researchers, the art is merely a by-product. The real goal is to study how brain impulses work together and can be harnessed, Bakkum said.

Ultimately, the research could be used to help create "neuroprosthetics" such as artificial eyes, eardrums or limbs that blind, deaf or paralyzed people could control with brain stimuli.

Someday the research could even be the basis for a new class of thinking, feeling and sensing robots that would bridge biology and robotics.

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GRAPHIC: Color Photo: Cox News Service; Prompted only by rat brain cells kept alive in a Petri dish, a robotic arm...; Color Photo: Cox News Service; ...creates drawings such as the one shown above.

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Times Colonist (Victoria)

July 13, 2003 Sunday Final Edition

SECTION: Arts; Pg. B10**LENGTH:** 370 words**HEADLINE:** Rat cells meld with robot to create 'semi-living artist': Machine uses brain impulses to scribble work on canvas**SOURCE:** Cox News Service**BYLINE:** Bob Keefe**BODY:**

Who says rats are uncultured vermin?

Researchers at **Georgia Institute** of Technology and the University of Western Australia have created a robot that uses the neural impulses of rat brain cells to draw pictures.

The living brains of the device dubbed the "Semi-Living Artist" stay in Atlanta, where they are nurtured in a petri dish in a lab decorated with a picture of the kitschy robot from the 1960s sci-fi classic *Lost in Space*.

Impulses captured by sensors are sent over the Internet to the machine -- basically a mechanical arm wired to a computer -- making it scribble on the canvas.

This weekend, the creation makes its U.S. public debut in New York's Chelsea art district, one of nearly 25 contestants in Eyebeam Gallery's "ArtBots: The Robot Talent Show."

The "Semi-Living Artist" is semi-talented at best. The work it produces with its three coloured markers isn't exactly *Still Life With Cheese*.

"Basically, it's abstract," said Douglas Bakkum, a **Georgia Tech** grad student and researcher on the project.

"When you take neurons out of the context they're usually in, they'll express themselves

anyway they want," Bakkum said. "Who knows what it's going to look like?"

For **Georgia Tech** researchers, the art is merely a by-product. The real goal is to study how brain impulses work together and can be harnessed, Bakkum explained.

Ultimately, the research could be used to help create "neuroprosthetics" such as artificial eyes, eardrums or limbs that blind, deaf or paralysed people could control with brain stimuli.

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National Post (Canada)

July 14, 2003 Monday National Edition

SECTION: Discovery; Pg. A11**LENGTH:** 375 words**HEADLINE:** Science taps in to creative side of rats: From Petri dish to finished canvas, via the Internet**SOURCE:** Cox News Service**BYLINE:** Bob Keefe**BODY:**

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